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Indexes for the twelve issues of the *Railway Mechanical Engineer* published during 1926, will soon be ready for distribution. These are sent only to those of our subscribers who place orders for them with our circulation department as it has been found that many of our readers have no use for them. If you wish to have a copy of the index to include with your bound volume or for use in referring back to the unbound copies, your order should be placed at once.

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Lubrication of machine tools

An authority on machine tools for a large railroad stated recently that the number of shutdowns of machine tools in railway shops could be greatly reduced if all machine tools were provided with positive force-feed lubrication to all high speed moving parts, and if a central oiling system were provided for the lubrication of all the other bearings and surfaces to be oiled. Most of the older types of equipment have the oil holes scattered all over the machine. This requires considerable time to oil the bearings, and if the operator is on piece work, he is likely to overlook some of the oil holes, with the result that maintenance cost increases. The numerous oil holes on some machines frequently become covered with chips, grease and dirt, so that the operator may not know of their existence. On some machines there are over fifty separate oil cups and oil holes which should receive daily attention. On machines of this type too much responsibility is placed on the operator with the result that there is considerable possibility that some of the oil holes will be overlooked and the bearings run dry. A ruined bearing may mean a costly shut-down. At the larger shop of one railroad, many of the machines have been provided, since installation, with a centralized oiling system, with copper tubes leading to the various points where oil is required. This is one method of solving the problem of inadequate lubrication. Most railroad shops of any size have one or more apprentice boys who could be used to oil the machines every morning. At first glance this may appear as a job not intended for one on whom the railroad is spending a tidy sum of money to teach him the machinist's trade. The major portion of the apprentice boy's time is devoted to learning how to operate machines. To be an all around machinist, he should also know the function of the principal parts of the machine. An alert apprentice, who wants to become well informed, can learn a great deal about different machines by repeatedly filling the oil cups and oil holes. He will learn to appreciate the importance of lubrication which, when he becomes a machinist, will react favorably to the management, as he will take care to see that his machine is properly lubricated and thus help reduce machine tool maintenance costs.

A query on engine truck repairs

The engine truck is not only one of the most difficult parts of a locomotive to lubricate, requiring constant attention and supervision to avoid hot boxes and resultant engine failures, but its maintenance presents difficulties of no inconsiderable magnitude. In the first place, the trucks usually come into the back shop after about a year of road service, literally covered with oil, grease, and dirt. Anything like an adequate inspection for frame cracks or wear in the parts is impossible until the entire truck has been thoroughly cleaned. The frames frequently have to be squared, center castings or swing bolsters given attention, loose bolts of all kinds tightened, springs and rigging overhauled, new wheels provided, boxes applied having the proper pedestal jaw fit and the correct lateral wheel play. Newly packed oil cellars are applied and binders bolted in place.

Engine truck work is one of the important jobs in the back shop and the *Railway Mechanical Engineer* would welcome descriptions from some of its readers of the best practice in handling this work, with particular reference to methods of keeping the truck frame itself a rigid operating unit. The stresses set up in engine trucks under the severe requirements of road service cause a great deal of working of frame and pedestal bolts and the practice has been followed to a certain extent in the past few years of replacing bolts with rivets. To what extent has this method been successful? What difficulties have developed? Can repairs be made as readily at outside points, or are such repairs rendered largely unnecessary by greater permanent rigidity in the riveted structure? These are a few questions apparently of considerable importance, occupying the minds of engine truck maintenance men at the present time.

Locomotive frame bolts

A prominent railroad mechanical engineer recently said, "A locomotive is as strong as its bolted connections," and the truth of this statement cannot be successfully questioned. Not only does a locomotive depend for its stability and performance on bolted connections but the cost of maintaining these connections tight is a serious item, if we may judge by the number of men and machines employed in the average railroad shop, making, fitting and applying frame bolts. Much can be done to reduce the cost of this work by cutting out entirely, or at least minimizing, the practice of making individual bolt fits each of which involves one or more trips between the locomotive and a bolt lathe.

The real salvation of the mechanical department, however, as regards locomotive frame maintenance has been the extensive introduction of steel castings to replace one or more parts previously joined with bolts. The manufacturers have performed a real service in developing steel foundry practice to a point where large, complicated steel castings are highly reliable against failure due to defects in the original material or poor design. A considerable number of locomotives are now in service having bed frame castings in which the side frames, front and back deck castings and all crossties are combined in a single steel casting. The latest development along this line has been the integral cylinder and bed frame casting, built by the Commonwealth Steel Company, for a switching locomotive of the Terminal Railroad of St. Louis. This one-piece casting is designed to take the place of 30 parts in the former design, to weigh 6,500 lb. less and to have approximately four times the strength.

The reason for the increased strength per unit of weight in a steel casting is that this construction permits using light sections, well-braced, in which deflections cause less stress in the outer fibers than in the case of heavy, concentrated sections of the conventional bar frame. This is illustrated by the relatively far greater outside fiber stress in a 6-in. square beam section than in a 4-in. square beam section of the same length when subjected to the same load. The generally larger fillets now being used in steel castings also contribute to greater reliability and freedom from breakage.

Your coach shop twenty years from now

Car department men whose work is more or less directly connected with the maintenance of passenger equipment will be interested in knowing that the Kingsland, N. J., coach shops of the Delaware, Lackawanna & Western, a description of the operation of which appears on another page of this issue, were constructed about twenty years ago. Yet a study of the drawing of the layout of the repair tracks and buildings will show that the location of the various buildings, shops and transportation facilities is in many respects as ideal for repairing the more modern all-steel or composite passenger cars as for repairing the earlier equipment of all-wood construction.

Many changes have been incorporated in the design of passenger cars during the past 20 years, the most important of which, from the standpoint of maintenance, are the adoption of all-steel and composite construction, the increased use of special service cars, the adoption of improved methods of lighting, heating and ventilating, and more complicated braking equipment. An outstanding advance is taking place in methods of painting.

Railroads encountering more competition for passenger business today than they did twenty years ago have placed a considerably larger burden on the shoulders of the car department officers in charge of passenger car maintenance. There is little likelihood of this burden ever becoming lighter. Today, the competition of the bus and automobile presents a real problem in obtaining passenger business. Passenger steamship lines are taking a new lease on life. Tomorrow the railroads will have to meet competition from the aeroplane. All of this competition is not, however, any reason to expect the railroads will eventually pass out of the passenger transportation picture. There will, in all probability, evolve a picture in which the railroads will be shown doing their part. Whether they will be in the foreground or in the background depends largely on the railroads themselves and no small part in the choice of final location in the picture belongs to the car department. Improved and more luxurious passenger equipment is certain to be built in the future and the improvements are likely to be of a more radical nature during the next 10 years than they have been in the past twenty years. These new developments will, of course, present new problems in maintenance.

The layout and construction of the Kingsland shops, originally built for the handling of repairs to cars of all-wood construction, is satisfactory today for the maintenance of passenger cars of modern construction. Quite a number of car department officers are working on just the same kind of a problem that the car department of the Lackawanna was confronted with twenty years ago. There are many of these officers who may well ask themselves the question, "will the passenger car repair facilities we are planning to build this year do the job twenty years from now?" In answering this question, the various trends in passenger car construction and in the changing character of the service requirements must be given consideration. The improvements made during the past twenty years have not presented very serious problems in maintenance, but car department officers will be required to solve more complicated problems in the future. Planning facilities for future passenger car repairs today is not as simple a problem as it was twenty years ago.

What will 1927 bring?

A glance at the operating records of American railroads during 1926 brings immediately the realization that a new standard in railroading has been established. Without reviewing in detail the statistics of actual performances, it is sufficient to draw attention to the fact that every month during 1926 broke all previous records in the case of the following six factors which are indicative of operating efficiency: Percentage of serviceable locomotives, freight car-miles per car day, gross and net tons per train, gross ton-miles per train hour and net-ton miles per train hour. In addition, the records made in the reduction of fuel consumed per thousand gross ton-miles were quite remarkable. No small part of the credit for the accomplishment for these performances should go to the men of the mechanical department. The records stand as an acknowledgment of the initiative and ability of those charged with the responsibility for solving the problems of operation and traffic and of those responsible for the design and maintenance of motive power and rolling stock. More intensive utilization of existing equipment has played a large part in making these performances possible. This factor has also imposed an added burden on the mechanical department which apparently has been shouldered with a spirit that has made it possible not only to keep pace with the increasing demands for serviceable locomotives and cars but, through improved methods and practices which more intensive operation has necessitated, the final result has been a decided improvement in maintenance conditions. This is indicated by the fact that the percentage of bad order cars in freight service at the end of the first 10 months of 1926 was 6.7 as compared with 7.9 for a similar period in 1925. For the same period the percentage of unserviceable locomotives in 1926 was 16.5 as compared with 17.9 in 1925.

While the number of new locomotives ordered during 1926 was not appreciably greater than during 1925, there is some significance in the fact that a large part of the 1,362 locomotives ordered for service on railroads in the United States and Canada are heavy, high capacity units designed to handle much greater train loads than the average of existing locomotives.

A standard of maintenance has been set of which the mechanical department can feel justly proud, yet at this time it is vital that mechanical officers be looking ahead in order that they may anticipate, so far as possible, any change in conditions which the coming year may bring about that will impose new or more difficult maintenance problems. The high pressure utilization of equipment cannot help but eventually wear down the comfortable reserve of motive power and rolling stock existing at the present time. On the other hand, the acquisition of modern motive power which in most cases taxes to the limit the present shop facilities brings a problem of maintenance that must be met. Far too many shops on American railroads are inadequately equipped with machine tools and shop equipment. If the mechanical department is to maintain the record so far established, it is imperative that the problem of modernizing our locomotive shops must be immediately and continually considered. During the past year the manufacturers of machine tools and shop equipment have brought out a great many new designs, many of which are particularly suited to the handling of railroad shop work in a manner which makes possible great savings in maintenance costs. If our locomotive and car shops are going to be in a position to supply the demand for motive power and rolling stock to keep pace with a continued record breaking traffic, many improvements which have been deferred must now be made in order to bring the equipment of these shops up to a point that will make it possible not only to handle an increased output but economically to maintain the modern locomotive with its many accessories. Mechanical department officers and supervisors may view with a certain amount of pride the accomplishments of 1926, yet at the same time they must not fail to consider the significance of the question "What will 1927 bring?" Preparation in advance is the safest course and to have intelligently prepared for emergencies which may arise will undoubtedly result in an improvement in operating performance during 1927 which will be the source of still greater satisfaction.

A year of better railroading

The past year is outstanding for the high degree of efficiency with which the railroads in America were operated. Indeed, the improvement in financial results is more due to the increase in the efficiency of operation than to the increase in the amount of business handled. According to figures quoted by Dr. Julius H. Parmalee, director, Bureau of Railway Economics, in the January 1, 1927, Railway Age, the operating revenues increased from $6,187,000,000 in 1925 to $6,476,000,000 in 1926, or 4½ per cent. This was the result of a six per cent increase in freight revenues; a decline of almost one per cent in passenger revenues indicates that the decline in passenger business which has been taking place for several years past has not yet been entirely checked. The efficiency of operation is indicated by the fact that total operating expenses increased but 2.7 per cent over 1925, to $4,705,000,000. The result is an operating ratio of 72.7 per cent for 1926 as compared with 74.1 for 1925, thus continuing a trend of improvement which has been unbroken since 1920. Maintenance of equipment expense increased from $1,269,000,000 in 1925 to $1,292,000,000 in 1926, or only 1.8 per cent.

While the railroads have been investing large sums in additional and improved facilities, the total amounting to $875,000,000 in 1926, it is significant that the amount of new equipment which was ordered during the year and the amount actually installed during the year is relatively small. The 1926 capital expenditures of the Class I roads of the United States aggregate $96,000,000 for locomotives, $210,000,000 for freight cars, and $55,000,000 for passenger cars. Including $40,000,000 invested in shops, enginehouses and in shop machinery and equipment, $401,000,000 (less than half of the total invested during the year) went into equipment and facilities within the jurisdiction of or used by the mechanical department.

During 1926, orders were placed for 1,362 locomotives by the railroads of the United States and Canada. This shows a small increase over the 1,065 locomotives ordered during 1925, but is still much below the average during pre-war days when orders seldom dropped below 2,000 and were frequently above 3,000 per year. During 1926, 1,185 locomotives were built for the railroads in the United States and Canada as compared with 994 in 1925, and although this also represents a relatively small activity, these locomotives were generally of large capacity. Those installed on the Class I railroads in the United States averaged 56,565 lb. tractive force and, after allowing for the locomotives retired during the year, effected a net increase of 26,000,000 lb. tractive force.

Orders for 68,995 freight cars were placed by the railroads in the United States and Canada, which is much less than the 93,458 cars ordered during the preceding year. The number of cars actually built during the year was also less than the number built during 1925. The larger capacity of the new cars, however, resulted in a net increase in freight car carrying capacity of about 900,000,000 tons, after allowing for retirements. An absence of practically any car shortage throughout the year, with a surplus during periods of greatest demands as high as, or higher than the average for the years from 1921 to 1925, indicates the high degree efficiency with which the available supply of equipment was utilized. The number of passenger cars ordered by the railroads in the United States and Canada during the past year was also much smaller than for any year since 1921. Orders were placed for 2,104; in 1925 orders were placed for 2,241.

The number of rail motor cars and trailers ordered last year changed but slightly from the number ordered in 1925. Orders were placed for 170 motor cars and 24 trailers in 1926 and for 171 motor cars and 19 trailers in 1925. With the growing capacity of power plants—a number of cars were ordered last year with double power plants aggregating from 400 to 500 hp.—the field for this equipment as a means of maintaining local and branch line passenger train service has been considerably extended. Unless the motor equipment has sufficient power to handle additional cars of milk or other express traffic, it is not available as a substitute for the steam train on many lines where relatively light passenger traffic is accompanied by a relatively heavy express traffic.

The improvement in operating efficiency which has reduced the operating ratio of the Class I roads as a whole from 93.7 per cent for 1920 to 72.7 per cent for 1926, is an accomplishment in which every department has participated, and none with more effectiveness than the mechanical department. Its contributions include better personnel relations, which in turn have had much to do with the splendid physical condition to which equipment has been brought without excessive expenditures, and they include much of the results of more intensive locomotive utilization. The department has also, in many cases, demonstrated the great value of adequate shop and terminal facilities, so that in the future there is likely to be less opposition to demands for improvements in this respect than there has been for so many years in the past.

Annual meeting of the A. S. M. E.

High pressure compound locomotive built by the Baldwin Locomotive Works

Railroad Division holds successful session—Featured by paper on the use of high steam pressures in locomotives

THE forty-seventh annual meeting of the American Society of Mechanical Engineers, held in the Engineering Societies Building, 29 W. 39th street, New York, was the largest meeting of its kind ever held in the history of the society, a total of 2,213 registering for the four days, December 6 to 9, 1926. Two papers and two committee reports were presented at the session of the Railroad Division, which was held at 2:00 p.m., Tuesday, December 7. An abstract of one of these papers, on balancing factors in the use of freight cars, by L. K. Silcox, general superintendent of motive power, Chicago, Milwaukee & St. Paul, was published in the December *Railway Mechanical Engineer*, page 743. A report on the year's progress in railway mechanical engineering was made by the chairman of the division, H. B. Oatley, vice-president, Superheater Company, and a report on the opportunities afforded the mechanical engineer in the railroad industry was presented by the Sub-Committee on Professional Service, an abstract of which will appear in an early issue of the *Railway Mechanical Engineer*. The paper on the use of high steam pressure in locomotives, presented by E. C. Schmidt, professor of railway engineering, and the late John M. Snodgrass, professor of railway mechanical engineering, both of the University of Illinois, was followed by considerable written discussion. Following is an abstract of this paper, together with abstracts of a number of the discussions:

The use of high steam pressure in locomotives

By Edward C. Schmidt[1] *and John M. Snodgrass*[2]

In the older current locomotives the working pressure lies generally between 180 and 210 lb. gage; in those of recent construction it varies from 200 to 250 lb. The last-mentioned pressure is still unusual, and of the 70,000 locomotives on the railroads of the United States, fewer than a thousand carry this pressure, which is the present maximum in locomotive boilers of standard design. The practice abroad has not differed much from our own in this respect.

In the use of high pressures, locomotive practice has lagged behind that in stationary plants, chiefly because of the difficulty of adapting the water-tube boiler to locomotive conditions. Within the last ten years the working pressure in central generating stations has been increased to about 600 lb. per sq. in.; and for special purposes, in small boilers of special design, the working pressure has been carried as high as 1,500 lb.

The firebox of the ordinary locomotive has extensive flat surfaces the proper staying of which becomes more difficult as the working pressure is increased. While the maximum pressure for which it is possible properly to stay the ordinary firebox is not yet definitely settled, it probably lies between 275 and 300 lb. In view of this fact and of the pressures in current use the term "high steam pressure" may be defined for the purposes of this presentation as a pressure of 300 lb. or more. Since, however, there are at present only two reciprocating locomotives using so high a pressure, certain facts are presented about those locomotives which operate at or near the usual current maximum pressure, namely, 250 lb.

Increasing the train load has always been, in American practice, the usual resort for attaining economy in general operation, and it has resulted in an unremitting demand for locomotives of greater capacity or tractive force. For the locomotive designer an increase in steam pressure is an easy way to a moderate increase in capacity, and there has been a steady increase in boiler pressure from the earliest days of locomotive construction; the progress, however, has thus far been made by small steps of 10, 15, or 20 lb. at one time, and it has generally involved no radical departures in design. Interest in higher pressure is no new thing; what distinguishes our present interest in the subject is that the contemplated pressure increases far exceed our previous changes—the pressure used in two American locomotives is 100 and 150 lb. in excess of the current maximum, and in the high-pressure locomotive of the German State Railways, the excess is 600 lb.

The advantages to be derived from high pressure

The reasons for considering higher pressure in locomotive service and the advantages to be derived from its use may be stated as follows: (1) The use of higher steam pressure results in a considerable decrease in steam consumption, and a corresponding—though slightly smaller—decrease in coal consumption. (2) Within the

[1] Professor of railway engineering, University of Illinois, Urbana, Ill.
[2] Late professor of railway mechanical engineering, University of Illinois, Urbana, Ill. Professor Snodgrass died on December 4.

usual fixed limits of width and height the locomotive designer may obtain greater tractive force and greater power by increasing the boiler pressure. It is fortunately possible to obtain simultaneously both of these benefits; and it is not necessary, as in some locomotive-economy-promoting devices, to trade economy for capacity or vice versa.

If the new high-pressure type of boiler proves ultimately to be inherently lighter than the present standard boiler, then, for a given total engine weight, it will be possible to obtain greater tractive force with high steam pressure; but we cannot know whether this will be true until the new type of boiler has been further developed and perfected.

The magnitude of the gains to be derived from high pressure is illustrated by the Rankine-cycle efficiencies shown in Table I, for pressures varying from 200 to 900 lb., at 250 deg. superheat, and an absolute back pressure of 20 lb. per sq. in. The fifth column shows the gains in efficiency expressed as percentages of that attained at 200 lb. pressure; it will be noted that 400-lb. steam gives 23.70 per cent greater efficiency than 200-lb. steam, and 800-lb. steam gives 46.88 per cent more than 200-lb. In view of the difficulties of utilizing extremely high pressures on locomotives, it is significant to observe that the increment of gain decreases as the pressure is increased. As indicated in the last column of Table I, the efficiency to be gained by raising the steam pressure from 200 to 300 lb., for example, is 13.75 per cent; whereas the gain by increasing the pressure from 800 to 900 lb. is only 3.75 per cent; in other words, while the total gain in efficiency secured by increasing the pressure from 200 lb. to 900 lb. is over 50 per cent, the first 100-lb. stage of the increase gives more than 3½ times as much benefit as does the last 100-lb. stage.

Table I—Showing Rankine-Cycle efficiencies for single-expansion cylinders, using steam at various initial pressures, superheat of 250 deg., and exhausting against 20 lb. absolute back pressure

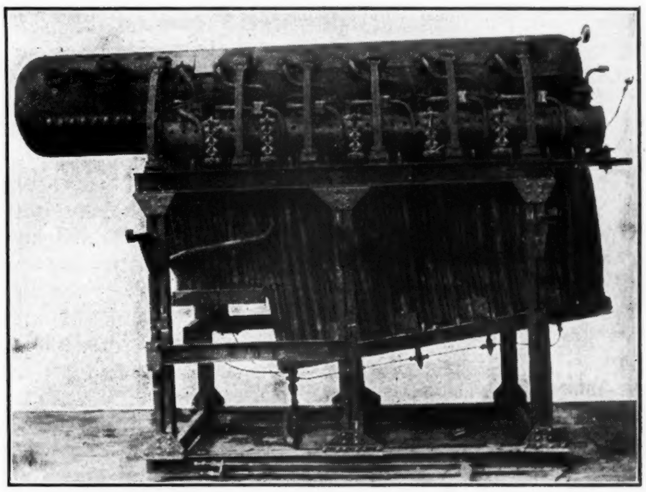
Initial steam pressure, lb. per sq. in. gage	Temperatures — Of the saturated steam, deg. Fahr.	Temperatures — Of the superheated steam, deg. Fahr.	Rankine-cycle efficiency, per cent	Gain in efficiency over that attained with 200 lb. initial pressure, per cent	Increment of gain, per cent
200	388.0	638.0	18.90	....	....
250	406.2	656.2	20.34	7.61	7.61
300	421.9	671.9	21.50	13.75	6.14
350	435.9	685.9	22.49	19.00	5.25
400	448.4	698.4	23.38	23.70	4.70
500	470.2	720.2	24.81	31.28	7.58
600	489.1	739.1	25.98	37.46	6.18
700	505.7	755.7	26.95	42.59	5.13
800	520.6	770.6	27.76	46.88	4.29
900	534.2	784.2	28.47	50.63	3.75

In reciprocating non-condensing engines operating with moderate pressure and under excellent conditions, the actual efficiency has proved to be from six-tenths to seven-tenths of the ideal efficiency shown in Table I. The proportion varies, depending on whether the engine is operated simple or compound, and upon the amount of superheat. There will probably be no very radical modification of this proportion with the use of higher pressure and we are warranted in expecting that the relation between the actual efficiencies at various pressures will not differ greatly from the relation between the theoretical efficiencies shown in the table. Such considerations make it certain that the gains attainable by the use of high pressures are considerable and well worth striving for.

As has already been pointed out, the second advantage, namely, the increase in tractive force attainable with high pressures, has always been of great importance and it has become more and more so as locomotive design has approached closer to the weight limits and to the space limits set by the track clearance, which have been nearly or quite reached in many instances. Anything which under these conditions will permit the designer to continue to produce a more powerful machine which will draw a heavier train is bound to be regarded as of the utmost importance by every railroad operating officer, for it opens again the avenue to highest operating efficiency and economy.

Both advantages are important, and which one is regarded as the more so will depend upon the circumstances. Probably in European practice, with their light train load and high fuel cost, the gain in economy will seem more important than the gain in power; although present fuel costs on American roads have mounted to a point where our attitude toward such an engineering problem must be quite different from what it might properly have been ten years ago.

There are some difficulties in the design and operation of high-pressure locomotives which, while probably not insuperable, ought nevertheless to receive due consideration. As has been intimated, the use of pressures above 300 lb. has entailed and will entail radical departures in boiler design. The experience with the Brotan boiler, having a firebox of watertube construction, has, however, been extensive and encouraging. Similar types of construction have been used in the Horatio Allen[1] and in the high-pressure locomotive built by Henschel & Sohn



High pressure boiler and water-tube firebox of the ultra-high pressure locomotive on the German State Railways built by Henschel & Sohn

for the German State Railways. While the maintenance of such boilers, the maintenance of valves and piping, and lubrication under high temperature will introduce problems new to the railroad man there is in the results attained in high-pressure stationary plants ground for the hope that these problems can be satisfactorily solved; and the experience of the New York, New Haven & Hartford with the McClellon boiler[2] offers similar encouragement.

In the opinion of many railroad men, one of the most serious problems to be solved in adapting the high-pressure water-tube type boiler to American railroad conditions lies in the almost universal use of untreated boiler waters on our railroads. Under the high temperature of the high-pressure steam the scaling is sure to be serious, and the proper washing and cleaning of these boilers will interpose a serious objection to their widespread use. Such an objection is not, of course, insur-

[1] *Railway Mechanical Engineer*, February, 1925, page 79.
[2] *Railway Mechanical Engineer*, March, 1926, page 143.

mountable, but it will undoubtedly greatly retard the adoption of high-pressure locomotives in many situations.

The maximum steam temperature which it is possible to carry without impairing the strength of the engine parts or without incurring unusual difficulties in lubrication remains to be determined. The maximum safe temperature is commonly held to be not over 750 deg. F., although the basis for this opinion is not generally stated. Fortunately the maximum steam temperature contemplated for locomotives does not greatly exceed this present limit. At 900 lb. pressure and 250 deg. superheat, for example, the temperature of the steam is 784 deg., which is only 146 deg. more than the temperature of 200-lb. steam with the same superheat (638 deg.). In high-pressure stationary plants the steam temperature runs in the neighborhood of 700 deg. to 725 deg. It seems likely that the difficulties arising from such increases in temperature as are entailed by the use of steam of even 900 lb. pressure can ultimately be overcome.

Experience in stationary plants

High-pressure steam has been experimented with and employed in stationary practice to a much greater extent than in locomotives. The common employment of water-tube boilers and the use of condensers in stationary plants, together with the limiting conditions found in locomotive service, have naturally led to the greater development in stationary practice. Experimentally, and to a considerable extent commercially, various steam pressures have been used up to as high as 1,500 lb. per sq. in. The use of steam pressure in the neighborhood of 1,200 lb. per sq. in. has received attention both in this country and abroad. A plant with a capacity of 150,000 lb. of steam per hour, designed for a pressure of 805 lb. per sq. in., is now in process of erection. Numerous stationary plants are in operation which employ steam pressures from 300 to 500 lb. per sq. in.

Use of high pressure steam in recent design

The use of high-pressure steam appears to have been accepted as the best practice in the design and operation of several large central power stations which have been built recently. Facts obtained from large-scale operations, together with opinions expressed by practically all other recent users of high-pressure steam and by builders of equipment for this service, indicate the practicability of using high steam pressures and temperatures and of obtaining and maintaining equipment which will be satisfactory for pressures up to 800 lb. per sq. in. or higher, and for temperatures up to 700 to 750 deg. F. Experience in stationary practice has satisfactorily answered many of the questions which have arisen regarding the employment of high pressures and temperatures. The special problems which arise in locomotive practice due to conditions peculiar to that service are being vigorously attacked. They appear to offer no insurmountable difficulties.

Discussion

V. L. Jones, assistant mechanical engineer, New York, New Haven & Hartford, emphasized the necessity of having to attack the problem of utilizing higher steam pressure by considering a general re-design of the locomotive boiler. The following is an abstract of his discussion.

The conventional type of locomotive in general use has just about reached its limit of capacity and economy with boiler pressures remaining in the neighborhood of 200 lb. per sq. in. gage. Refinements of details are possible, but major increases in capacity and economy, it would appear, are only possible through radical increases in steam pressure. Anything but nominal increases in pressure must necessarily produce extensive changes in design and modifications to existing standard practice.

The authors, in discussing the matter of greater tractive force and greater power, point out that it is fortunately possible to obtain simultaneously both these benefits and it is not necessary, as in some locomotive devices, to trade economy for capacity or vice versa.

This is a most important feature and cannot be stressed too strongly. Too often it so happens that devices for promoting locomotive economy force a compromise in some other feature of the design. All of which means that attention to improvement of the locomotive must be handled by always keeping in mind the effect on the plant as a whole, rather than magnifying the importance of any one portion of the boiler, engine or auxiliaries. For example, it is perfectly feasible and proper to divide the locomotive into two main sections, namely, the evaporating plant and the steam using plant, or in other words, the boiler section and the cylinder section. Up to the present time it has been the general practice to add devices and equipment to a boiler which, basically, does not differ from designs laid down over 20 years ago. As a result, limitations peculiar to locomotive conditions, have been reached. We are now forced to attack the problem on the basis of a general re-design of the entire evaporating plant, giving proper consideration to each step necessary in transforming cold water from the tender into high pressure steam available for use in the cylinders. The feed heating section, the evaporating section and the superheating section of the boiler must all be properly proportioned as a part of a complete design, rather than the system of starting with a standard type boiler and adding thereto feed water heating and steam superheating equipment.

Weight and space are at more of a premium in locomotive work than is ever approached in stationary or marine service.

It would appear that to date the ultra high pressure boiler of the German State Railways represents a more complete development of the matter than any equipment now in service on other railroads, either at home or abroad. This is particularly true when the question of water tube fire boxes and bad water is considered; it being noted that the German design restricts the fluid in the water tube sections within a closed system, all of which amounts to nothing more than a combination of boiler and condenser.

There is further evidence of proper coordination in the German design when it is noted that the use of moderate pressure steam in the low pressure cylinders is combined with the high pressure boiler feature with very good results from a heat balance standpoint.

Professor Schmidt mentions that the use of higher pressures carries with it increasing difficulty on account of scaling, washing and cleaning of locomotive boilers due to the almost universal use of untreated water. In some sections of the country the quality of water for boiler feed is extremely bad, resulting in high maintenance and loss of use of locomotives. With the staybolt type of fire box construction, these troubles increase very definitely with an increase in pressure, but with the use of a water tube fire box construction, there does not appear to be quite as much difficulty in fire box inspection, cleaning and general maintenance. The experience with the Brotan fire box in Austria and experience in this country with the Muhlfeld and McClellon fire boxes justify this statement.

This leads to the logical statement that the more gen-

eral use of water tube construction should produce definite benefits through allowing greater capacity and greater power output from the boiler plant, with an ultimate reduction in maintenance and loss of use. This is another illustration of the importance of increased economy and increased capacity without the necessity of trading one for the other.

It is believed that the use of higher pressures will be generally in vogue in the years to come. We cannot, however, remain with the present standardized form of locomotive design without reaching very definite limits in boiler pressures and axle weights. As a result, locomotive design must undergo a fairly general change and development with the necessity of always co-ordinating all features of the evaporating section and the steam using section so that the net result obtained can be measured in terms of greater economy and capacity at the tender drawbar without suffering exorbitant increases in weights and costs.

Of necessity there must be modifications or changes or both to the running gear, in order to match up steam distribution characteristics with the change in pressure. Any appreciable increase in boiler pressure must take into account the probability of multiple expansion in the cylinders. Compounding introduces difficulties, it is true, and likewise the use of more than two cylinders is productive of complications, but unless these difficulties are faced squarely and overcome, the use of steam pressures in excess of 250 lb. gage will be extremely limited. It is not a simple matter to increase the boiler pressure indefinitely without due provision for proper expansion in the cylinders. Unfortunately railroad experience in the past brought results that were not of the best and a return to single expansion with the use of superheat eliminated the use of compounds and more than two cylinders. It looks, however, as if multiple expansion must come as a necessity when boiler pressures exceed approximately 300 lb. pressure.

It is therefore apparent that any appreciable increase in boiler pressure beyond approximately 250 lb. per square inch will carry with it the necessity for a general re-design of practically the entire locomotive.

The widespread interest in the use of higher pressures and the proper means to attain the end in view, coupled with the progress that has been made to date, should produce results in the future in keeping with the importance of the subject.

Experience with fire-tube boilers in past years has been satisfactory

A. I. Lipetz, consulting engineer, American Locomotive Company, discussed the advantages of higher pressures from the point of view of greater tractive forces and greater power that have been realized for years, and if it were not for the difficulties involved in the construction and maintenance of locomotive boilers at those pressures, we would have had them long ago. In this respect it is interesting to recall that when the compound locomotive, which had caused a previous rise in boiler pressures, was supplanted by the superheated locomotive and the pressures were temporarily lowered, the innovation was welcomed by many railroad operators who were eager to reduce their boiler maintenance expenses. However, it did not last long, as the call for larger power revived the tendency of increasing boiler pressures, although the rise did not go on very rapidly.

The question of the suitability of the water tube high pressure boiler to the peculiar conditions of locomotive service merits separate consideration. This will also explain the reason for the delay in the application of high pressure steam to locomotives in the past, and will enable us to foresee the possible forms of its application in the future.

The multi-fire-tube boiler of the early locomotive is something with which the locomotive designer would not willingly part, as a hundred years' experience has taught him that this boiler is not only reliable, low in first cost, and compact, but also insures great evaporation capacity in the small space available on a locomotive and within the permissible limits of weight. Besides, it has the great advantage of heat storing capacity which is necessary in view of the constant variation in the load factor of a locomotive. Even in stationary plants, if the load factor fluctuates considerably, it is now customary to add a heat accumulator, usually of the Ruths type, to high pressure boilers. An attempt was made by Robert in France to depart radically from the conventional locomotive boiler type; he built in 1904 the first and only watertube boiler for a locomotive, without any tubular part at all, but this attempt met with very little success, and has never been repeated.[1] All further designs, those of Brotan, McClellon, Muhlfeld and of the Schmidt Company of Germany, have the characteristic longitudinal barrel with fire tubes inside, thus retaining the heat storage feature of the ordinary locomotive boiler.

The barrel design is not easily adaptable to high pressures; nevertheless we have already in this country two locomotives with boilers of this type carrying 350 lb. gage pressure, and a third locomotive with even higher pressure is now under construction. The thickness of the barrel plates is already approaching the safe limit of manipulation by cold bending. It would seem, therefore, that 400 lb. represents the highest pressure for the type of boiler in which the barrel portion is subjected to the full pressure of the steam, unless we go to special steel for the barrel plates. As regards design, it will probably evolve into a combination of a watertube firebox with a barrel fire tube portion, embodying the best features of the McClellon and Muhlfeld boilers—this, of course, provided that the higher cost of the boiler and its maintenance due to possible scaling, etc., will not overbalance the economy in fuel. As a gain we shall still have the increase in power of the locomotive of a given weight as a result of lesser steam consumption, although possibly without much saving per unit of power.

Reverting to the Rankine-efficiency table given in the paper, we see that by increasing the pressure from 200 to 400 lb. per sq. in., we increase the ideal efficiency by 23 per cent—this including the gain from the higher temperature of superheated steam. In order to make full use of the increase in ideal efficiency, it is necessary to maintain at least the same efficiency ratio. O. H. Hartmann's tests have shown that this is possible, if compounding is resorted to. It is very likely, though, that poppet valves with separate admission and exhaust passages will prove to be sufficient for single expansion from pressures in the neighborhood of 400 lb. per sq. in., without compounding, if the steam is superheated to 725 deg. or 750 deg. F. In either case, compounding or higher superheat will simply enable us to maintain a constant efficiency ratio, thus gaining the total 23 per cent due to the higher Rankine efficiency. It is, therefore, erroneous, as is sometimes being done in figuring out the advantage resulting from higher pressure, to add the gain from compounding determined by experience with low pressures to the increased Rankine efficiency of the higher pressure. Nevertheless, it is safe to figure that by increasing the boiler pressure from 200

[1] R. Garbe. Die Dampflokomotive der Gegenwart. Second edition, 1920, pages 192-193.

to 400 lb. per sq. in. or by doubling the pressure, we may gain about 23 per cent in power.

If a further increase in power is desired, higher pressures must be used. Another increment of gain amounting incidentally to 23 per cent can be obtained by a further doubling of pressure from 400 to 800 lb. per sq. in.[1] However, it would be hardly advisable to use large riveted drums for these pressures and high temperatures, and it is questionable whether forged drums can be manufactured sufficiently cheap to be suitable for locomotive use. The German high pressure boiler described in the paper represents an interesting arrangement in which the watertube firebox is separated from the firetube barrel, thus permitting to raise the pressure in the former to 800 lb., lowering at the same time that in the latter to 200 lb. per sq. in. The whole locomotive with its two-pressure boiler, double expansion of steam, mixing of low pressure superheated steam with the exhaust steam from the high pressure cylinder, resembles a modern high pressure stationary installation consisting of a high pressure watertube boiler, a two-stage expansion engine or turbine and a Ruths storage heat accumulator between the high and low pressure engines. The locomotive is complicated, but it seems to be the only logical solution of using a really high pressure boiler on a locomotive without subjecting the tubular drum to the high pressure of the steam.

In this particular instance the construction is still more complicated by using the indirect method of steam generation. It has the advantage, though, of permitting the use of distilled water in the hottest part of the boiler, thus eliminating any scale formation inside the water tubes; in addition, the lower part of the high pressure drum is not exposed to the hot gases in the firebox. This arrangement may prove to be of great value for districts with bad untreated water; for railroads with fair, or treated water, the indirect steam generation will probably represent an unnecessary complication, and it is possible that an ordinary watertube boiler in combination with a low pressure tubular boiler may turn out to be just as good a proposition.

It must also be added that in the two-pressure boiler only part of the working steam has 800 lb. pressure, the other part being of 200 lb. only. The total gain in ideal efficiency will be, therefore, less than the 46 per cent given in the table, and it will depend upon the ratio of steam generated in the high pressure boiler to the total amount of steam. However, if this ratio could be kept somewhere between 70 and 80 per cent, the total gain may still amount to 30 or 35 per cent, which is indeed well worth striving for.

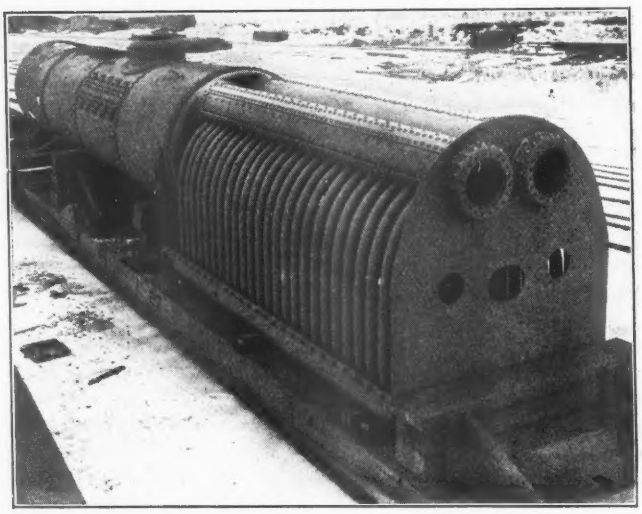
It seems, therefore, that we may have in the future two types of boilers—one of the connected water- and fire-tube type for pressures in the neighborhood of 400 lb. per sq. in., and another of the separated water- and fire-tube type for higher pressures, probably about 800 lb. gage pressure. In both cases superheat will probably be between 700 and 750 deg. F. until material which can withstand higher temperatures becomes an ordinary market product. Only experience will teach us which of these two types is best suited to railroad service. It is possible that the moderately high pressure boiler will be preferred in many cases, at least in the near future. Later, however, if the price of coal should go up, higher pressure, or as the authors call it, ultra-high pressure, may become justifiable.

In this connection, and in conclusion, it may not be amiss to mention the study which G. G. Bell, West Penn Power Company, made last year on the question of the most economical pressures for stationary plants with coal prices of $3.00, $6.00 and $9.00 per ton. His conclusions were that the higher the cost of coal and the higher the load factor, the more advisable is the use of high pressures. For the reheating cycle the most economical pressures were between 340 and 500 lb.; for the regenerative cycle they were higher—between 440 and 600 lb.[1] This would indicate that there is no need for going beyond 500 lb. per sq. in. for locomotives. This would also seem to be in agreement with the investigations of Prof. A. G. Christie who favors pressures of only 400-500 lb. per sq. in. with very high superheat.[2] However, it must be borne in mind that the high evaporative rate required from a locomotive boiler may substantially change these findings, and that actual experience with locomotives of both types is needed.

[1] This incidentally shows that the increments of Rankine-efficiencies vary approximately in arithmetical progression when pressures vary in a geometrical progression, following very closely the parabolic law.

The Baldwin high pressure locomotive

Lawford H. Fry, metallurgical engineer, Standard Steel Works, Burnham, Pa., discussed the figures given in Table I of the paper to illustrate the gain in efficiency made possible by the use of high steam pressures, which he said needed amplification, and gave a short description of the high pressure locomotive built by The Baldwin Locomotive Works for the Pennsylvania together with some of the results of tests made with it on the Pennsylvania locomotive testing plant at Altoona, Pa. An abstract of his paper follows.



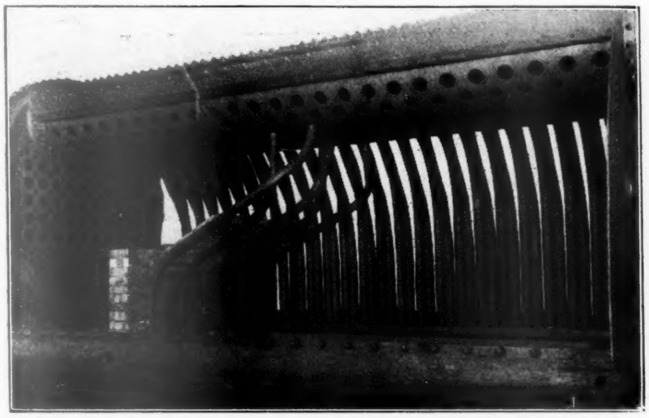
The completed firebox of the Baldwin high pressure locomotive ready for the application of the firebrick walls

The calculations as to the efficiency of increased pressures, from which the figures in Table I were obtained, are based on a constant superheat of 250 deg. so that an increase in pressure is accompanied by an increase in steam temperature and also by an increase in the total heat of the steam. The increases in efficiency are, therefore, not necessarily due alone to the increases in pressures. Now unless a radical change is made in existing locomotive boiler designs an increase in steam temperature will not be obtained or will represent a considerable loss in boiler efficiency. It, therefore, appears preferable to base comparisons not on uniform superheat, but on uniform steam temperature, say 650 deg. F. This will give about 260 deg. superheat at 200 lb. and about 175

[1] Serial report of the Prime Movers Committee, National Electric Light Association, on higher steam pressures and temperatures, July, 1926, pp. 20-21.
[2] Ibid, pp. 4-7.

deg. superheat at 600 lb. per sq. in. Also the total heat will fall off with increasing pressure, being approximately 1,340 B.t.u. for 200 lb. and 1,325 B.t.u. for 600 lb. per sq. in. The efficiency shown by the Rankine cycle under these conditions is about 30 per cent better for 600 lb. than for 200 lb. per sq. in.

It is suggested, however, that the Rankine cycle is not a good basis for comparing locomotive cylinder efficiencies. It assumes that the steam is expanded adiabatically from boiler pressure all the way down to the exhaust pressure, which latter is taken in the paper to be 20 lb. per sq. in. absolute. With steam of 200 lb. per sq. in. this means an expansion of about 6½ times and with steam of 600 lb. per sq. in. an expansion of nearly 17 times. These do not represent conditions realizable in any existing reciprocating locomotive design. With single expansion cylinders expansions up to 3 or 3½ are usual, while with compound cylinders the expansion can be carried to 4 or 5. It is suggested that for comparing locomotive cylinder efficiencies the ideal cycle should be based on admission at boiler pressure, adiabatic expansion to a definite number of expansions, say three, then release to exhaust pressure and exhaust at that pressure. On the basis of such a cycle the gain shown by high pressures will be very much less than those shown by the unattainable Rankine cycle with its impossibly high expansions for high pressures. From such an analysis and from a study of test results it seems proper to conclude that the gain actually obtainable by the use of high steam pressures in locomotive practice, though less than those indicated by the figures in Table I, will be substantial. At the same time as pressures are increased it becomes important to aim at an increase in the expansion of the steam.



Firebox of the Baldwin locomotive with one side removed showing the arch tubes carrying the brick arch

This discussion is not intended to throw doubt on the usefulness of high pressures in locomotive work, but to suggest that the thermodynamic problems are so complicated as to deserve much more thorough analysis than is given in the paper. For those desiring to make a further study of the question attention is called to a very complete paper on "The Economic Value of Increased Steam Pressure" by H. L. Guy, which was read recently before the Northwestern Branch of the Institution of Mechanical Engineers, and reported in *Engineering,* November 9, 1926.

This paper considers stationary practice with steam at a constant temperature of 700 deg. F. exhausted to a vacuum of 29 in. of water and concludes that under these conditions, when installation and operating costs are taken into consideration, the best economic results will be obtained with pressures from about 400 to 600 lb. per sq. in.

Time available here does not permit any such detailed study being applied to locomotive conditions, and it seems better for the present to remain on the firmer ground of practical experience. Pressures of 240 and 250 lb. per sq. in. are, as the authors point out, firmly established in American practice. In fact the figures given as to the number of such locomotives in service should be increased considerably. The Pennsylvania has now in operation over 600 2-10-0 type and 200 4-8-2 type locomotives using 250 lb. per sq. in., and to the water tube firebox locomotives must be added a 4-10-2 type three cylinder compound with 350 lb. per sq. in. built as an experiment by The Baldwin Locomotive Works. Actual measurements indicate that on the Pennsylvania locomotives the increase in pressure from 200 to 250 lb. per sq. in. gave a decrease of about 9 per cent in steam consumption, and that an increase to 350 lb. per sq. in. will give a further decrease of about 10 per cent. The gains in efficiency and the possibility of securing a large tractive force with cylinders of moderate size make pressures of 250 to 400 lb. per sq. in. worthy of careful consideration by locomotive designers, but if pressures in excess of 250 lb. per sq. in. are used it seems desirable to eliminate the use of staybolts in the boiler and to adopt a cylinder design capable of giving a high degree of expansion.

The main dimensions of the Baldwin Locomotive Works 350-lb. three-cylinder compound 4-10-2 type locomotive with a water tube firebox are as follows:

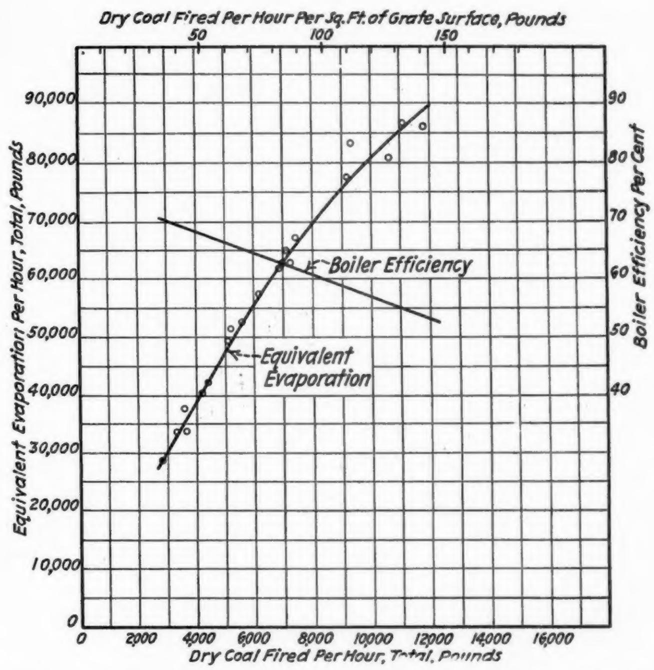


Fig. 1—Evaporation and boiler efficiency curves of the Baldwin locomotive

Cylinders, diameter and stroke:	
High pressure (1) inside	27 in. by 32 in.
Low pressure (2) outside	27 in. by 32 in.
Diameter driving wheels	63½ in.
Heating Surfaces:	
Firebox and arch tubes	772 sq. ft.
Flues and tubes	4,420 sq. ft.
Total evaporative	5,192 sq. ft.
Superheater, type A	1,357 sq. ft.
Grate area	82.5 sq. ft.
Weight on driving wheels	338,400 lb.
Total weight of locomotive	457,500 lb.
Rated tractive force (compound)	82,500 lb.

The general appearance of the locomotive differs in no way from that of a locomotive of the usual construc-

tion. The front view shows the three cylinders which are controlled by three individual valve motions. The cylinders are compounded. The steam after passing through the middle cylinder is exhausted through a receiver in the cylinder saddle to the two outside cylinders.

The boiler pressure is 350 lb. and to carry this pressure satisfactorily the firebox is of a modified Brotan design. One of the illustrations shows the outside appearance of the complete firebox before the firebrick sheathing is applied, and another illustration shows the box with one side removed showing the arch tubes carrying the firebox arch which separates the front part of the box from the rear. The grate is applied back of the arch and the front portion of the firebox forms a combustion chamber.

The locomotive was exhibited at the A. R. A. convention of 1926 and then after being broken in on road service was tested at Altoona on the Pennsylvania locomotive testing plant. A complete report of these tests is not yet available for publication, but through the courtesy of J. T. Wallis, chief of motive power, Pennsylvania, a few advance figures are available.

Fig. 1 shows the power and efficiency of the boiler. An equivalent evaporation of 85,000 lb. per hour was attained with about 11,900 lb. of dry coal fired per hour. At this maximum rate of firing the boiler efficiency was about 52 per cent. The results do not differ from those to be obtained from a boiler of conventional design. This was expected as the water tube construction was adopted for the purpose of carrying the high pressure and not with the idea that it would give greater efficiency.

Fig. 2 shows the water rate per indicated horsepower in relation to the horsepower developed. This shows that in two tests the locomotive indicated 4,500 horsepower. In both of these tests this power was sustained continuously for an hour and could have been exceeded, but the capacity of the locomotive test plant had been reached.

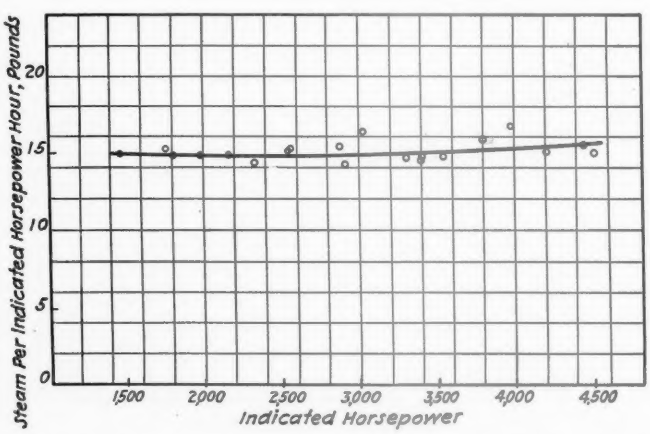


Fig. 2—Water rate per indicated horsepower-hour of the Baldwin locomotive

The water rate remains extremely uniform for all horsepowers betwen 1,500 and 4,500, and is little affected by variations in speed and cut-off. At speeds from 15 to 37.5 m.p.h. and cut-offs from 50 to 80 per cent in the high pressure cylinder the steam per indicated horsepower-hour varied from 14.2 to 15.4 lb. In full gear with 90 per cent cut-off in the high pressure cylinder the water rate was 16.3 lb. at 15 m.p.h. and 16.6 lb. at 22.5 m.p.h. The dry coal per indicated horsepower-hour as shown by Fig. 3 runs from 1.9 lb. at low powers up to 2.7 lb. at 4,500 horsepower.

Since coming off the test plant the locomotive has been in road tests on the Pennsylvania and on the Baltimore & Ohio. The results in road service confirm those obtained on the test plant. No serious operating troubles have developed, and it is believed that the economy shown will compel locomotive designers in the future to give careful consideration to high pressures and long expansions.

Utilization of high pressures in stationary power plants

James M. Taggart, consulting engineer, New York, in discussing Professor Schmidt's and Snodgrass's paper, said that the advance attempted appears to be rather

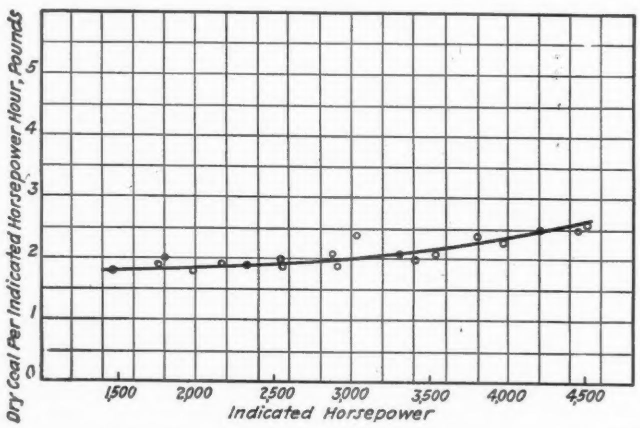


Fig. 3—Coal rate per indicated horsepower-hour of the Baldwin locomotive

slight compared to the advance in steam practice made in other lines of engineering. The locomotive built by Henschel & Sohn is the only one suited for real high pressures. This unit with its three pressures seems to be a very complicated machine with respect to its boiler alone. Its value has not as yet been determined.

The ideal locomotive would be one equipped with a complete water tube boiler, probably of the explosive type, with water tube furnace walls, a suitable superheater, economizer sections, air preheater, equipment for burning pulverized coal, engines on the uniflow principle, feed water heating, and air cooled condensers.

To install all of this apparatus on a locomotive and tender may appear at first glance impractical. The advantages of the inclusion are apparent to any one familiar with present power plant practice and the requirements for traction service. A study of what has been done in the power plant field, the automobile service and on railroads, will show the feasibility of at least trying to work out the combination.

Pulverized coal burning experience has shown that a greater combustion intensity can be maintained with pulverized coal than with any other form of coal burning. For locomotives reduction in furnace volume as well as the resulting reduction in labor attendant are of special value.

To absorb the radiant heat from such a high intensity of combustion without serious burning of tubes, would require, of course, an exceptionally clean feed water. To do so safely also would require special high temperature steel. The condenser would tend to assure a cleaner feed than usual and the make up would have to be a treated water. The recent success in rolling high chromium steel tubes provides a material that should be suited for the water tubes exposed to the furnace radiation. In addition, portions of these tubes as well as the superheater surface could be covered with some

of the special refractories such as carborundum if found desirable.

The use of both pulverized coal and the explosive type of boiler would give a very quick steaming and an instant response to a change in loading.

The inclusion of economizer sections and an air heater would allow for a minimum of boiler heating surface and a higher economy than could be attained with boiler surface alone.

The use of the uniflow principle in the engine cylinders would give the same advantages as compounding without as much complication. It would also provide a higher economy for changeable loads and for low back pressures.

Introduction of an air cooled surface condenser is probably the most radical step suggested. Present practice with automobile air cooled radiators and the condensers of steam automobiles as well as experience with steam air heaters using forced draft show that it is not at all an impossible solution. It is probable it would not pay to install a condenser of sufficient surface to give a low vacuum for all conditions. During periods a circulating fan would undoubtedly be necessary. During the cooler months when running at average speeds, a fairly low vacuum should be obtainable without the use of circulating fans. The main advantage of the condenser would be to assist in maintaining a clean feed water and to eliminate the necessity of carrying a heavy load of water.

A further obstacle would present itself to many engineers. This is the oil that would necessarily be present in the feed water. Experience, however, shows that with the high temperature steel tubes suggested, a small amount of oil if of a good grade for the service may not be dangerous. If found necessary, filtering could be used with a renewal of the filtering material at the end of each run.

The best results that have been attained even under tests with the combination water and fire tube boilers treated of in the article was about 2.3 to 2.5 lb. of coal per drawbar horsepower. Considering the standby losses, the uncertainty of hand firing, etc., it is probable that average results would not show lower than 4 lb. of coal per drawbar horsepower. With the equipment suggested, an efficiency at least twice as good should be possible. Again with the complete water tube boiler, especially of the explosive type, there would never be the present danger of explosion.

The arrangement of a locomotive containing the features proposed would naturally be different from present practices. The condenser would probably need to be in the front. The tender carrying the make up and coal would occupy much less volume. There would be no need of the room now required for hand firing. The reduction in total weights due to the lighter boiler, smaller size cylinders, smaller weight of water and coal would probably be fully equal to the added weights of the economizer air heater and condenser. As is brought forth in the article, piping and valves for high pressures if properly designed should not give trouble.

Bureau of Locomotive Inspection annual report

Conditions show tendency to overlook repair of defects frequently considered unimportant

THE 15th annual report of A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, to the Interstate Commerce Commission stresses the fact that although there was a substantial decrease in the total number of accidents during the year ending June 30, 1926, a still greater decrease should have resulted had the requirements of the law and rules been complied with, especially with respect to defects the repair of which are frequently considered unimportant. Boiler explosions caused by crown sheet failures continue to be the largest source of fatal accidents, 17 of the 22 fatalities from all locomotive failures during the year being attributable to that cause.

The report contains a summary of all accidents occurring during the year ending June 30, 1926. A total of 574 accidents occurred in the 12 months' period covered by the report, a decrease of 16.8 per cent from that of the preceding period. There is, however, an increase of 10 per cent in the number killed over the preceding 12 months. During 1926-25 a total of 22 persons were killed as compared with 20 for 1925-24. The number of injured, however, shows a decrease from 764 during 1925-24, to 660 during 1926-25.

The greatest number of accidents was due to defective squirt hoses of which there were 51. Thirty-eight accidents were due to defective grate shakers, 37 to defective reversing gears, 26 to defective flues and 22 to crown sheet failures on account of low water. Fifteen accidents were due to crown sheet failures caused by low water for which contributing causes or defects

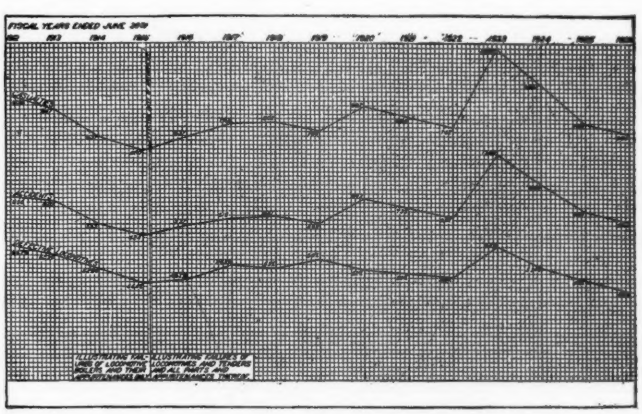


Chart showing the relation of defective locomotives to accidents and casualties resulting from locomotive failures

were found. Fifteen accidents were also caused by defective couplers.

An abstract of the report follows:

Mr. Pack's report

A summary of all accidents and casualties to persons as compared with the previous year shows a decrease of 16.8 per cent in the number of accidents, an increase of 10 per cent in the number of persons killed and a decrease of 13.6 per cent in the number injured during the year. There was also a substantial decrease in the percentage of locomotives inspected by our inspectors found defective. During the year 40 per cent of the locomotives inspected were found with defects or errors in inspection that should have been corrected before being put in use as compared with 46 per cent for the previous year and 53 per cent for the year ending June 30, 1924.

Number of locomotives reported, inspected, found defective, and ordered from service.

Parts defective, inoperative or missing, or in violation of rules	1926	1925	1924	1923
Air compressors	2,151	1,574	1,221	1,390
Arch tubes	204	198	272	468
Ash pans or mechanism	211	216	257	306
Axles	8	14	19	21
Blow-off cocks	280	825	965	1,578
Boiler checks	1,200	991	1,329	1,913
Boiler shell	1,888	1,597	2,103	2,370
Brake equipment	7,062	6,497	6,920	8,213
Cabs or cab windows	2,666	2,541	1,627	1.423
Cab aprons or decks	1,307	1,165	1,293	1,476
Cab cards	696	665	758	1,449
Coupling or uncoupling devices	394	447	398	634
Crossheads, guides, pistons, or piston rods	3,018	2,922	3,577	5,527
Crown bolts	334	283	418	630
Cylinders, saddles, or steam chests	5,080	4,352	5,712	4,875
Cylinder cocks or rigging	1,904	1,801	2,376	1,745
Dome or dome caps	463	371	494	626
Draft gear	2,634	2.283	1,981	2,613
Draw gear	3,140	3,273	4,160	4,513
Driving boxes, shoes, wedges, pedestals, or braces	3,342	3,241	3,722	4,269
Fire-box sheets	1,129	1,152	1,471	2,327
Flues	556	524	698	1,268
Frames, tail pieces, or braces, locomotive	1,973	2,036	2,580	2,683
Frames, tender	373	391	414	540
Gauges or gauge fittings, air	886	694	626	1,062
Gauges or gauge fittings, steam	2,038	1,809	2.026	3,075
Gauge cocks	3,068	3,081	3,835	5,895
Grate shakers	720	832	1,006	569
Handholds	3,100	2,831	2,241	1,990
Injectors, inoperative	78	70	94	251
Injectors and connections	8,303	8,064	9,985	12,406
Inspections or tests not made as required	10,646	10,436	9,740	7,419
Lateral motion	758	659	939	1,625
Lights, cab or classification	106	86	72	90
Lights, headlight	946	928	904	1,164
Lubricator or shields	883	704	565	566
Mud rings	1,458	1,384	1,901	2,711
Packing nuts	2,772	2,761	3,304	4,755
Packing, piston rod and valve stem	2,489	2,411	3,187	3,359
Pilot or pilot beams	638	832	967	1,294
Plugs or studs	1,087	849	1,026	857
Reversing gear	1,539	1,274	1,217	1,272
Rods, main or side, crank pins or collars	5,683	4,813	6,507	10,080
Safety valves	270	234	188	192
Sanders	1,769	2,004	1,806	1,857
Springs or spring rigging	6,826	5,532	6,335	7,911
Squirt hose	975	1,008	1,221	1,098
Staybolts	905	741	916	1,313
Staybolts, broken	3,582	3,745	5,320	10,089
Steam pipes	1,587	1,590	2,305	2,467
Steam valves	962	869	981	1,168
Steps	3,227	2,867	2,829	3.289
Tanks or tank valves	3,430	3,352	3,393	3.788
Telltale holes	487	451	620	715
Throttle or throttle rigging	2,618	2,403	2,868	2,633
Trucks, engine or trailing	2,860	2,956	3,425	3,899
Trucks, tender	4,929	5,372	5,977	3,714
Valve motion	1,576	1,250	1,269	1,761
Washout plugs	3,649	3,588	3,204	3,641
Water-bars or combustion flues	44	19	18	24
Water-glass, fittings, or shields	3,621	3,713	4,201	5,641
Wheels	2,243	2,148	2.996	4,371
Miscellaneous—Signal appliances, badge plates, brakes (hand)	1,702	1,510	1,342	972
Total number of defects	136,973	129,239	146,121	173,840
Locomotives reported	69,173	70,361	70,683	70,242
Locomotives inspected	90,475	72,279	67,507	63,657
Locomotives defective	36,354	32,989	36,098	41,150
Percentage inspected found defective	40	46	53	65
Locomotives ordered out of service	3,281	3,637	5,764	7,075

While there was a substantial decrease in the total number of accidents during the year, our investigations indicate that a still greater decrease should have resulted had the requirements of the law and rules been complied with, especially so with respect to defects the repair of which are frequently considered unimportant.

Boiler explosions caused by crown-sheet failures continue to be the most prolific source of serious and fatal accidents with which we have to deal, 72.7 per cent of the fatalities during the year being attributable to this cause. The importance of properly maintaining water-level indicating appliances that will accurately register the water level in the boiler under all conditions of service and which may be easily and accurately observed by the occupants of the locomotive cab from their usual and proper positions, can not be overemphasized. The use of the strongest practicable firebox construction, especially within the area which may be exposed to overheating due to low water and the application of a device that will give an audible alarm when the water level approaches the danger point, would be distinct steps forward in the reduction of accidents and casualties resulting from crown sheet failures.

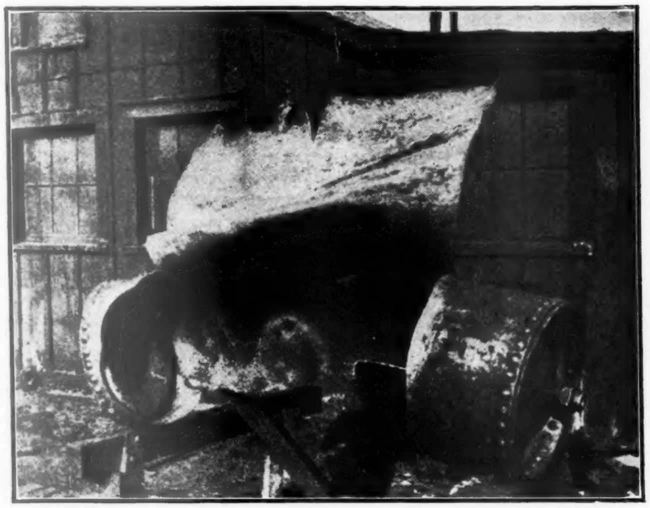
Cracks developed in sections of three driving wheel tires which had worn flanges built up by fusion welding

Our investigations of reduced body staybolt breakage show that failure most frequently occurs in the reduced body at or close to the fillet joining the body of the bolt and the enlarged ends, and telltale holes which do not extend into the reduced section at least 5/8 in. can not be depended upon to indicate broken bolts.

A great majority of broken staybolts are found by leakage through telltale holes without the aid of the hammer test. The sound and vibration when staybolts are hammer tested varies with the location of the bolts in the firebox and also with the shape of the firebox. Inspectors depend upon the telltale holes as a check of the

results of the hammer tests. If the telltale holes do not extend into the bolts to or beyond the usual point of breakage, they are not only useless as a safety feature, but become a distinct menace to safety.

No prosecutions for violations of the locomotive in-



Main air reservoir which exploded—The sheets were weakened by corrosion

spection law were instituted during the year. Three cases pending at the beginning of the year were disposed of. Judgment was assessed against the carrier in one case, one case was compromised upon payment by the carrier of the penalties sued for and judgment was ren-

Water glass practically closed by the gasket being squeezed over the end—The glass was too short when applied

dered by the court in favor of the defendant in the third case.

Three formal appeals were taken from the decisions of our inspectors during the year, two of which were dismissed. Two items were involved in one of the appeals, one of which was dismissed while the carrier was sustained in the other.

In conformity with the established practices in the formulation of rules and instructions, conferences were held with interested parties and a code of rules for inspection and testing of locomotives other than steam was formulated and agreed upon, which was approved by order of the commission dated December 15, 1925, and made effective July 1, 1926.

In my former reports recommendations were made in accordance with section 7 of the act, as amended, for the application of automatic fire doors, power reverse gears, power grate shakers, automatic bell ringers, horizontal hand holds, stirrups on cabs, and water columns with water glass and gage cocks attached, with an additional water glass located on the left side or boiler back head and reasons therefore given.

Many of the carriers are recognizing the value of these appliances in the promotion of safety, efficiency and economy and are complying with the recommendations in many cases, while others are not; therefore, the recommendations are respectfully renewed and should be made a requirement of the rules.

Audible low-water alarms are now being experimented with successfully and are being applied by many of the carriers. The general application of a dependable low-water alarm would be of inestimable value in reducing the number of serious and fatal accidents.

Informal apprentice instruction

By Warren Ichler

IN a large railroad shop of the middle west a rather elderly mechanic was assembling the steam chest, D slide valve, valve yoke, steam chest cover and related parts, on a small engine when an apprentice asked him how the length of the yoke could be obtained from the engine without the aid of drawings.

The question answered

Patiently, yet rapidly, the mechanic explained that the valve must have a travel equally great on each side of the center line of the exhaust port and since the extent of the travel of the valve on each side of this center line must be identical with the swing of the rocker arm, since the two were rigidly connected by the valve rod and yoke, it followed that the rocker arm must be in the center of its swing when it stood perpendicular. With this fact established it would be an easy matter for machine operators to set the rocker arm perpendicular with a plumb line or square and to measure the distance from the center line of the rocker to the center of the exhaust port; which length would equal the length of the valve yoke from the center of the valve fit to the end of the extension rod from the yoke to the rocker, plus the length of the extension rod from the end of the rod to the center pin or bolt connecting the extension rod or valve rod to the rocker arm. Then, since the extension rod was nearly always available for measurement, its length could be subtracted from the original measurement and the length of the valve yoke from the center of the valve fit to the end of the fit in the extension rod would be ascertained.

What the answer revealed

The whole explanation was given in clear simple language and took up very few minutes of the machinist's time and would have passed unnoticed but for the fact that a little questioning of the apprentice, a few days later, revealed the fact that there were only two or three machinists in a gang of more than two hundred whom

he cared to approach with such queries. This inspired some further questioning of other apprentices to find out, if possible, whether this reticent attitude was general among them or whether the apprentice first mentioned was unusually timid or bashful.

From these inquiries this fact was gleaned. The apprentices usually hesitated to ask questions about their work or their trade, for fear of ridicule or impatience coming from the mechanics they approached. Said one, "they either tell us that we have instructors paid to answer our questions and that we should go to these instructors, or else they poke fun at us, or tell us that we'll learn these things as we go along and shouldn't bother them with questions unless we are working with them directly on the job about which we are asking." The effect of this attitude on a whole trade is worth serious consideration.

Three forces in apprenticeship training

If we consider only the purely technical side of the training of an apprentice, we may tentatively reduce the influences contributing to his trade schooling to three forces in those shops were apprentice schools are maintained. The first of these forces is, of course, individual effort. Within this force are contained such contributing elements as individual study, supplementary reading, experiment and observation. The second of these major educational forces in the formal instruction offered to apprentices or made a compulsory part of their apprentice training. The third force or influence is the informal training acquired from association—in other words, such knowledge as can be gleaned from questioning fellow workmen.

Of course where no apprentice instructors are employed and where apprentice classes are not maintained, the second force merges with the first and the apprentice receives formal instruction in night classes, continuation schools, etc., only in proportion to his individual efforts.

Of course, all of the three forces mentioned bulk differently in individual lives, hence cannot be analyzed or weighed relatively. Purely as a tentative analysis of their comparative value the writer would say that with the average apprentice the first force contributes about 65 per cent of the sum total of his trade education; the second 20 per cent and the third 15 per cent. This valuation of intangible elements is inserted to invite comment and criticism primarily and for convenience of expression secondarily.

Neglecting the first two of these forces or rather assuming that they have been discounted in choosing apprentices by selecting physically fit and mentally alert boys with fair schooling and good heredity and environment, and have further provided them with good instructors, classrooms and study courses, the question still persists, "what are we doing about the third elemental influence—the 15 per cent force?"

The problem of informal training

Right here, we run into an intangible wall of buck-passing. Mechanics will say that it is a duty of supervisors or paid instructors. The supervisors will plead lack of time, and the instructors say that some of this instruction work must be taken care of by mechanics. Since it is manifestly impossible for shop instructors to be everywhere at once, a great many questions have to be postponed or unanswered under such conditions as outlined.

Here is where the older mechanics can be fitted into the apprentice training program to best advantage. Employed, as they usually are, on the lighter work where physical effort does not dull their mental energy or render them irritable, they should be encouraged to answer questions about operations both within and without their particular job. It is more than probable that their longer experience will compensate for their absence from heavier operations and they will still be able to give clear answers to queries about jobs which they have not handled for some time. In one large railroad shop with which the writer is familiar, the best adviser the apprentices have and one of the most progressive mechanics in the shop is a man well over sixty years of age who has done nothing but grind cab valves for years but has kept up an active interest in all phases of locomotive repairing.

The thought introduced in this paragraph is probably not new, but new or old, it is offered for the consideration of supervisors, instructors and mechanics. Briefly it is this; let the apprentice instruction forces be augmented by the appointment of apprentice advisers from among the older men; the duty of these advisers being to give informal instruction to apprentices seeking information.

A careful selection of these advisers would insure fair treatment of apprentices and concise answers giving in simple language the information wanted. By giving additional compensation, say 2½ cents per hour over the shop rate to these advisers, they would be made to feel a direct responsibility for this phase of their daily work in addition to the pride in this evidence of trust and respect.

With definitely supervised sources of information accessible at all times it is reasonable to expect the dissemination of knowledge of many of the short-cut methods, shop kinks, etc., that now remain hidden from many young men until long after the completion of their apprenticeship period.

Christmas banquet of the Missouri-Kansas-Texas Apprentice Club at Parsons, Kan., December, 1925

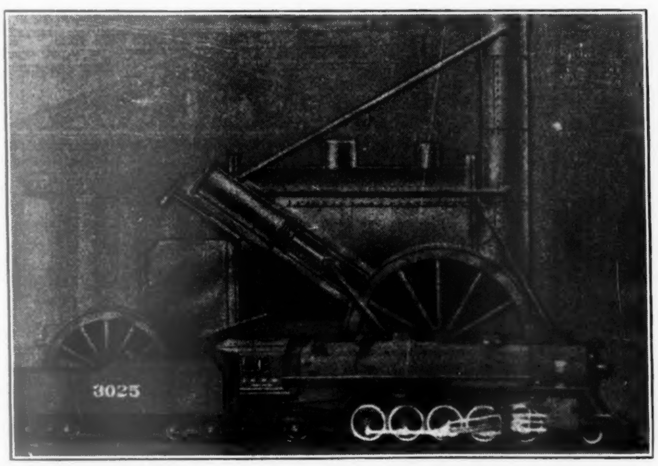
Engineering in recent locomotive developments

Steps in combining boiler and engine improvements to form efficient unit of high capacity

By W. E. Woodard
Vice-president, Lima Locomotive Works, Inc.

The following article is an abstract of a paper presented before the Western Railway Club at Chicago, December 20, 1926. In his presentation, the author made extensive use of moving pictures in the form of animated graphs and drawings developed step by step on the screen. These were supplemented with purely illustrative moving pictures and with slides of completed graphs. This method of presentation, employing a new application of the moving picture, made it possible for the audience to assimilate a volume of highly technical engineering data which would probably have taxed the capacity of the best informed had it been presented in the usual form of a written paper illustrated by slides alone. The illustrations in the abstract are, with two exceptions, selections from the slides.

EVEN a casual study of the growth of American railways during the past 20 years develops many subjects of interest to the engineer. During this period the railways have, to a notable degree, made use of the products of scientific and engineering research for

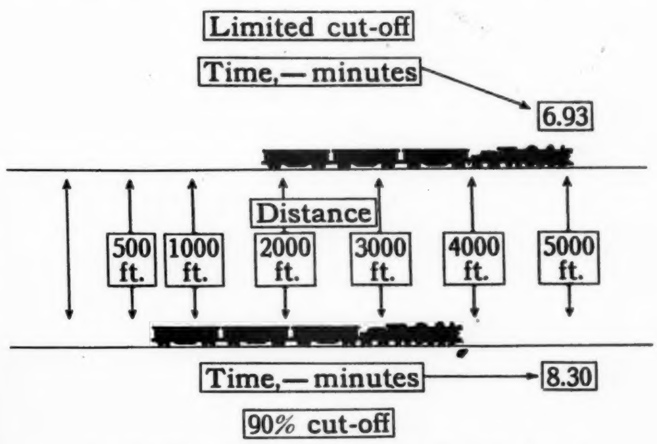


Imaginary "Rocket" with power equivalent to that of a modern locomotive

the improvement and more efficient use of their transportation plants, and thus any study of our railways leads at once into the field of engineering.

In such a survey of rail development, one fact stands out prominently, namely, that while main line track mileage has not materially increased during the past 20 years, there has been an enormous increase in the amount of business handled, and that the railroads have only been able to handle this increase by vastly increasing the traffic capacity per mile of track operated. (This increase in traffic capacity compared with the increase in main line mileage was indicated in the first moving picture, which was followed at short intervals by three others showing the effects of grade reduction, modern signaling and hump yard car retarders in making this greater traffic density possible.—Editor).

In this traffic expansion, the advance is steam locomotive design has contributed its full share by increasing the size and speed of trains, and has been the largest single factor in making this expansion possible. It would be an interesting story did time permit to trace the evolution of the locomotive from the "Rocket" to



Acceleration improvement with limited cut-off

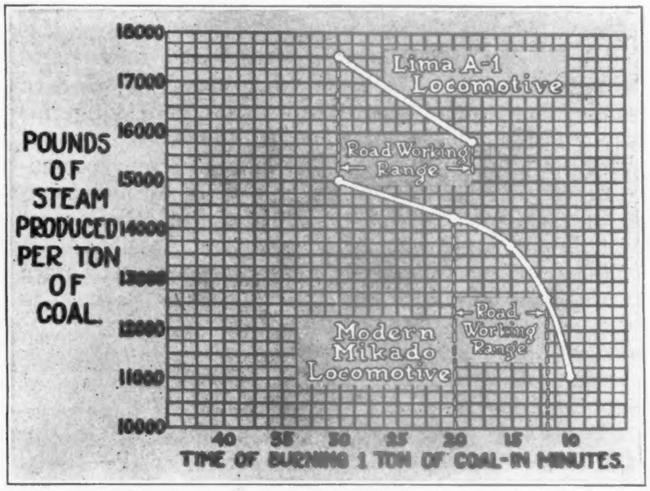
the modern power plant on wheels. The modern locomotive contains the same essential elements as the "Rocket"—an internally-fired steam boiler, cylinders and wheels—but this combination unaided by the developments which steam engineering has produced since Stephenson's time would be ludicrously inadequate for our requirements.

Superheating, feedwater heating, mechanical stoking, high boiler pressures, all helped in this evolution. They have largely made possible the production of locomotive designs capable of meeting modern traffic conditions. Fine locomotives were being built embodying these and other improved features of design and were bettering by large margins the performance of typical locomotives of 10 or 15 years ago. However, it was becoming apparent to students of locomotive engineering that we had about exhausted the possibilities of these combinations for further improvement, particularly as we were up to the limits of wheel loads and physical clearances in almost all of our locomotives. This was the reason for starting the series of tests and experiments which I will illustrate for you and by which we hoped to find ways still further to advance the locomotive art.

The natural approach to this problem was a survey of the trend of operating requirements. The increase in the volume of traffic moved over each mile of main line

track per day was accomplished by moving heavier trains faster, which is an increase in gross ton-miles per train hour.

The increase of 123 per cent in gross ton-miles per train hour in the past 20 years means that there has been a proportionate increase in the power output of the locomotives required to do the work. The increase in the power output of the locomotives is not exactly proportional to the increase in gross ton-miles per train hour, as factors such as better signaling and train operation have had some effect. However, without going into an extended analysis of these figures, it can safely



Effect of large grate area on boiler capacity and steam production

be stated as a fact that the increased power demands upon the locomotive during this period are nearly proportional to the increase in gross ton-miles per hour.

Now, power output demands steam, and steam requires coal for its production. Thus, logically, the first step toward improving locomotive designs led to a study of combustion conditions in road service. It had been apparent for some time past that we were reaching a very definite limit in steam generating capacity of our locomotives, because of the fact that the firebox and grate area set a limit to the amount of coal that could be burned and, in turn, the size of grate was fixed by the weight which could be carried on one trailer axle. Moreover, this trailer axle generally had to carry a stoker, a heavier ashpan, and often a booster.

An example will illustrate what I mean by the firebox and grate limitation. A railroad came to us with this problem: It was necessary for them to use two Pacific type locomotives over certain parts of their line in order to make the schedule of their through passenger trains. They wished to get one locomotive capable of doing the work. An analysis of the power output required to pull the train and a study of the proportions of the locomotives revealed the fact that while the cylinders of one engine were capable of developing the required power, the grate and fire box were totally inadequate to generate the amount of steam needed for the power output. Two engines had to be used in order to get a combined grate area sufficient to produce the steam required to pull the train, even though the cylinders on one engine could produce the power. The size of the grate and firebox absolutely limited the work which these locomotives could do.

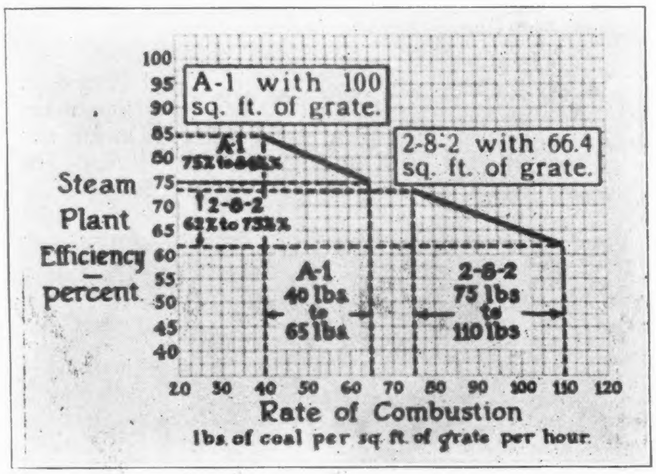
It is a familiar experience to most of you to see a locomotive, when being pushed hard, reach a point where it seems to quit. It really does. The firebox has reached the point where it cannot digest any more fuel, and no additional power can be coaxed out of that locomotive, irrespective of how much coal is fed to her.

Thus, you will see the logic of going after the combustion situation in locomotive designs. Cylinder proportions might be increased, steam pressure raised, driving wheels added, but to what avail if the grate is not made big enough to burn the coal necessary to produce the steam demanded by the increasing gross ton-miles per hour. This was the reason for the introduction of the four-wheel trailing truck.

Tests showed that with a grate area of 66.4 sq. ft., an average Mikado locomotive boiler has a maximum capacity of 65,520 lb. of steam per hr. while the Lima A-1, 2-8-4 locomotive boiler, with a grate area of 100 sq. ft. and burning the same amount of coal has a maximum steam capacity of 74,450 lb. per hr.

These tests and studies were directed to an investigation of the combustion conditions in locomotives; they were concerned with the steam-producing portion of the locomotive. What follows relates to our studies of the steam-using portion.

For years various attempts had been made to improve the efficiency of the engine cylinders in using steam. Superheating made the greatest advance in this direction by reducing cylinder condensation and thus saving steam. Compounding and uniflow cylinders



Effect of large grate area on steam plant efficiency

represent less effective efforts in the same direction.

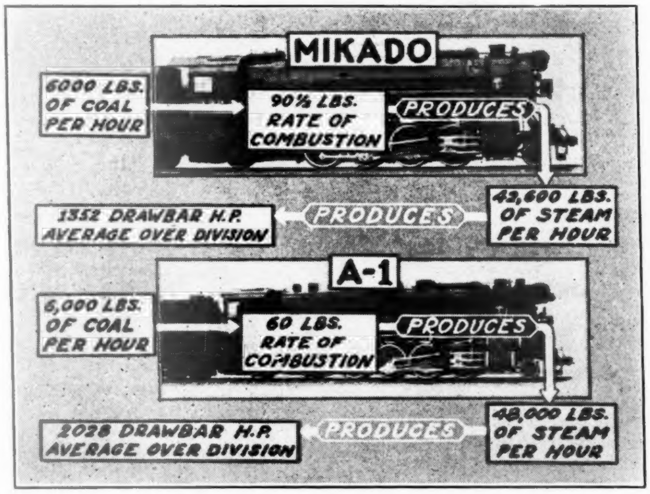
Limiting the maximum cut-off in the engine cylinders was being practiced by one large railway system and, without doubt, was reducing steam consumption. It did this because limited cut-off engines run at a shorter average cut-off than full-stroke engines and thus secure the advantage of a more expansive use of the steam. While the economy of these locomotives was well known, the possibilities of the limited cut-off scheme for increasing the power output per unit of driving wheel weight did not appear to be recognized.

When we began to consider the use of limited cut-off as a means of improving locomotive design, there was one question about its use which was not fully answered; namely, would a locomotive with limited cut-off get away as quickly and accelerate a train as rapidly as a full-stroke locomotive of equal starting effort? Possibly the sound of a full-stroke locomotive pulling its train out of a station led some to believe that it would accelerate faster than the less noisy and thus, apparently, less energetic limited cut-off locomotive. The

answer to this is given in one of the drawings.

The use of limited cut-off necessarily involved heavier piston thrusts, because more power is being produced from a cylinder of given size. This led, logically, to a study of rod and pin conditions. No elaborate data is needed to convince this audience that the conventional design of locomotive rods and pins has reached, if not passed, the limit of power which this construction can carry. Various cures for hot pins and brasses, like floating bushings, are used, but they do not get at the root of the trouble. The cause is not removed; the effect is only made less troublesome.

And thus it was that in 1924 we made a set of experimental rods and tested out in service a new scheme aimed to remove the design limitation set by the conventional rod drive by transmitting the piston thrust to driving wheels back of the main wheels without having it go through the main crank pins. Service tests showed that the new rods ran successfully and met all road and maintenance conditions. This form of rod drive is in use on about 150 locomotives in this country and is also being tried out in England.



Increased work from the same amount of coal.—Comparative tests of A-1 and 2-8-2 type locomotives

I have pointed out the vital importance of power output in locomotive design. As weight limits have remained about stationary and as the boiler and firebox are the primary sources of power in a locomotive, it naturally follows that if we can reduce the weight of any of the parts outside of the boiler and put that weight into the boiler, we will be increasing the power output by the amount of boiler added.

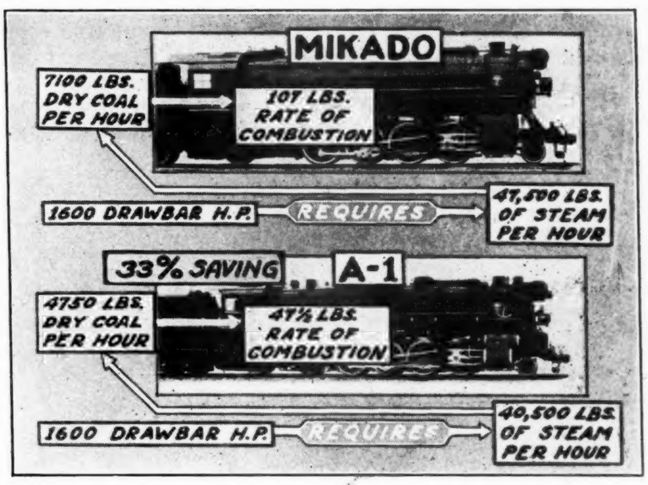
Until 1924 little had been done with cast steel locomotive cylinders. As many of you know, steel cylinders had been made, but their use was certainly not encouraged by the producers of steel castings. With the help of the Ohio Steel Foundry Company, we produced a cast steel cylinder design which overcame the objections of the foundry people, and to try out its practicability a set was made, machined and tested. The weight saving was more than 4000 lb. per pair of cylinders over those made of cast iron.

Large numbers of this design of cylinder have been produced and there now appears to be very little difficulty in getting either this or the conventional design in cast steel.

After these studies and experiments assured us of the correctness of our ideas, the various elements were combined and developed into a complete locomotive design, which one of the large railway systems of the country had the enterprise and courage to assure us they would try out. The engine was built and the design is now represented by 105 locomotives in service. To what degree the design has met expectations can best be shown by its accomplishments.

To be sure this locomotive is more complicated than the engine of a few years ago, but what machine can be mentioned that has not become more complicated as its range of usefulness and accomplishment has been extended? While I do not remember having heard the term "full-jeweled" applied to this locomotive, it has been used to describe many modern designs by persons who evidently failed to grasp the significance of the engineering advance represented by what they were pleased to call "jewelry." It is evident that as the requirements of safety, rapidity, and efficiency of operation, as well as the amount of work to be done, advance, machinery to meet these requirements becomes more complicated. The intricacies of a New York subway car are relatively great but it represents the most intensive, safe and economical transportation in the world.

After breaking in the A-1 on the Boston & Albany, extensive dynamometer car tests were made. These results were comparable with similar tests made about one year previous with a 2-8-2 locomotive of thoroughly modern design, having a Type "E" superheater, a feedwater heater, and a booster. The comparison is of special interest, because the two locomotives had almost exactly the same driver-wheel weight. The figures used in the following chart are average for a large number of runs of each locomotive. Weather conditions favored the 2-8-2, as the tests of that locomotive were run in August, while the A-1 tests were run in late winter.



Saving in coal for the same work.—Comparative tests of the A-1 and a 2-8-4 type locomotive

Steam produced per hour, lb.

Lb. coal per hour	2-8-2 66.4 sq. ft. grate	A-1 100 sq. ft. grate	Increased by A-1 with large grate area
5,000	36,200	42,000	5,800 lb.
5,500	39.600	45,000	5,400 lb.
6,000	42,600	48,000	5,400 lb.
6,500	46,000	51,000	5,000 lb.

The range available for overload in the boiler having the big grate and firebox is illustrated, being made possible by the four-wheel trailer truck design. The relative usefulness of the two boilers can best be shown by the overall efficiencies of the boiler, superheater, and feedwater heater in combination. Both boilers have Type "E" superheaters and are equipped with feedwater heaters of the same type; therefore, the comparison is a fair one, and by reducing the comparison to an ef-

ficiency basis the difference in steam pressure is accounted for.

Passing to the steam-using portion of the locomotive, some very interesting comparisons were obtained showing the effect of the limited cut-off on steam consumption. As I have said, the tests of the 2-8-2 type locomotive were run over the same division as those of the A-1, with about the same train loading. The results of the limited cut-off may be summarized as follows:

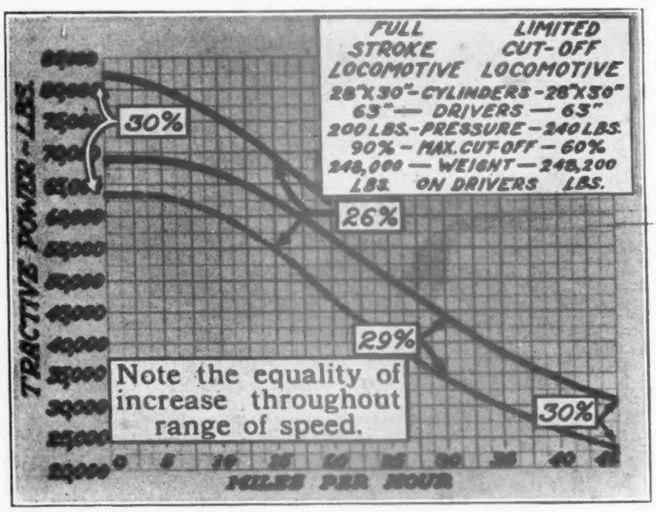
Average saving of 17½ per cent by use of limited cut-off

Indicated horsepower (Avg. over division)	Total water per hour, lb.	Steam per i.hp. hr., lb.
A-1 (60 per cent maximum cut-off)		
1,800	37,400	20.8
1,900	39,200	20.6
2,000	41,200	20.4
2-8-2 (90 per cent maximum cut-off)		
1,800	44,700	23.8
1,900	46,900	24.7
2,000	51,200	25.6

Thus we have two factors working in conjunction with each other to produce economy in fuel; namely, the reduction in amount of steam required per unit of work—which, of course, reduces the demands upon the boiler for a given amount of work—and, then, the boiler, which on account of its large grate is capable of producing this amount of steam much more economically than the boiler having the smaller grate. Each economy reacts upon the other, with the result shown in the two pictures, one showing the saving in fuel for the same work and the other the increased work which can be secured from the same amount of coal.

We have found from many years of experience in building locomotives that while economy in fuel is very essential consideration in any new locomotive unit, it alone is not enough. A factor of equal if not greater importance is increased capacity to pull cars.

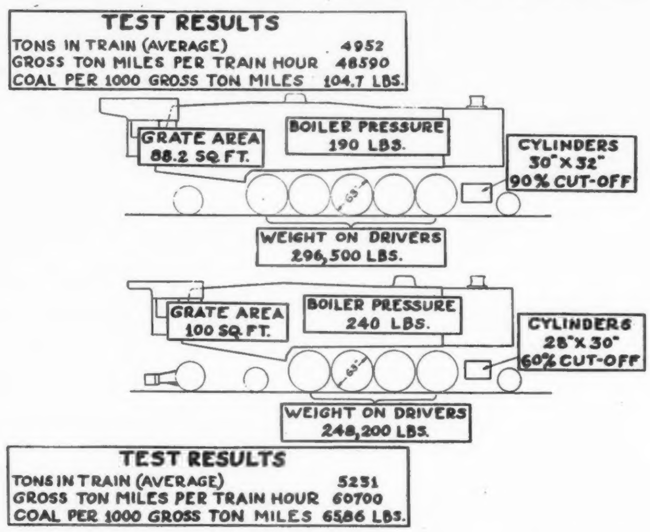
High-pressure, limited cut-off cylinders increase the capacity of the locomotive in two ways. First, by raising the starting power of the engine on account of the more even torque, which permits the use of more tractive force on a given driver-wheel weight. With limited cut-off we are able to get about 30 per cent more pull at speed than can be obtained out of the same driver-wheel with full-stroke cylinders.



Comparison of the tractive force of a full stroke and a limited cut-off locomotive of the same weight on drivers

The tractive force which can be obtained out of this driver-wheel weight with full-stroke cylinders is very definitely set by the factor of adhesion and it is about 63,000 lb. The amount of pull at speed which can be obtained out of these full-stroke cylinders has also been well established for years past. For example, full-stroke cylinders giving a starting tractive force of 63,000 lb. will give a pull of 34,000 lb. at 30 miles per hour, and this is all that can be obtained out of these cylinders at that speed. Now, with limited cut-off we get a starting tractive force of 69,400 lb., but at 30 miles an hour these limited cut-off cylinders will give about 44,000 lb.

You have seen how the limited cut-off cylinders increased the power output at speeds and how we utilized the booster to add pulling capacity at low speeds, thus maintaining the increase throughout the speed range.



Comparison of test results of the A-1 and a modern 2-10-2 locomotive on the Illinois Central

Now, this increase in power over the full-stroke engine having the same driver-wheel weight corresponds very closely with the increase which can be obtained from a full-stroke cylinder locomotive having one more pair of driving wheels and larger cylinders. In other words, if this curve be true a 2-8-4 having four pairs of driving wheels, plus the booster, ought to equal in service a 2-10-2 full-stroke locomotive having five pairs of driving wheels and no booster. It actually works out this way, as is shown by the data comparing the A-1 locomotive and a 2-10-2 locomotive of good modern design.

This is simply another verification of the fact which I have emphasized many times; namely, the use of high-pressure, limited cut-off cylinders backed up by an adequate boiler gives greatly increased power output per unit of driver-wheel weight over a full-stroke engine. These same principles of design are applicable to any class of locomotive.

In any talk where improved elements of construction are discussed, very frequently and very properly someone asks the question, "What next?" We ought to keep our minds open and always be looking ahead. In that respect, I feel that the question is a proper and desirable one. But there is one other aspect of this question—"What next?" that I would like to present to you.

(Mr. Woodard here presented a moving picture showing graphically that as compared with a capacity of 100,000 gross ton miles per hour and dry coal consumption of 3 lb. per drawbar horsepower-hour for the A-1 type locomotive, 31½ per cent of the freight power in the country produces but 60,000 gross ton miles per hour at 5½ lb. of coal per drawbar horsepower-hour, and 61½ per cent of the freight power but 45,000 gross ton miles per hour, at 6½ lb. of coal per drawbar horsepower hour.

The operation and testing of draft gears

A discussion of the methods used in testing and their importance in draft gear design

By A. F. Stuebing
Chief engineer, The Bradford Corporation, New York

THE principal reason for applying draft gears to cars is to avoid damaging the car structure when cars come together. The draft gear offers a yielding resistance and thus cushions the impact. The draft gear also facilitates the starting of trains and reduces the force of the jerks when the slack between cars is taken up. Many persons believe that a draft gear which has absorption reduces the force passing through it to the car structure while a spring gear does not. This is incorrect. The force exerted on the car underframe by the gear is the same as the force exerted on the gear by the coupler or yoke regardless of the type of draft gear. There is practically no difference in the operation of spring and friction draft gears of equal capacity during closure. The distinction is that when the spring gear opens it gives back almost all the work done in closing it, while the friction gear gives back a much smaller part of the work done in compression, the rest being absorbed. These features are very important and will be mentioned again in the discussion of car impact.

Testing of draft gears

Various methods have been devised for testing draft gears, including static tests, drop tests, rivet shearing tests and car impact tests. The characteristics of spring gears can be determined very well by recording the closure under a static testing machine. But for the majority of friction gears, this test is not reliable. The low speed of closing causes some gears to show much higher resistance while others may be lower than under actual service conditions.

Drop Tests.—Drop tests are usually regarded as giving the best indication of the performance of draft gears in impact. In making drop tests the gear is given a few preliminary drops to clean the surface and remove high spots. A 9,000-lb. hammer is then dropped from gradually increasing distances until the springs or housings close. In comparing the results of drop tests the total fall, or the distance the weight is raised about the gear plus the travel of the gear itself, is usually given. This is the proper basis of comparison, because the work done in closing the gear is proportional to the total drop. Some draft gears manufacturers give the drop test results as the free fall, or the distance the weight is raised above the gear. In this case, the height of the drop is not proportional to the work done, and furthermore, the comparison on this basis is unfavorable for gears with long travel. The drop test is ordinarily used only to ascertain the drops required to close the gear and to destroy it.

The question is frequently asked, what is the force of the blow if the 9,000-lb. weight drops from say 30 in. There is no satisfactory method of computing this. If the drop is not sufficient to close the gear, the force can be estimated with a fair degree of accuracy if the distance that the gear was compressed is known. After the gear is driven solid the force increases very rapidly. A few inches over the solid point would send it up to more than a million pounds with a sturdy gear. If the gear is weak, the force will not increase so rapidly.

Car Impact Tests.—The test which most nearly duplicates conditions in actual service is the car impact test as made on the Symington test plant. This is described in detail in the account of the U.S.R.A. tests. Car impact tests afford a means of measuring the forces set up in impact and will show definitely if the force is reduced through the action of friction. The report of the U.S.R.A. tests states in discussing draft gear action:

"The force exerted between the cars in compressing the gears and car structure is entirely independent of the question of absorption. Up to the point of maximum compression, the matter of absorption of energy has not entered into or influenced the problem. It is entirely a question of force and yield and it should be remembered that frictional resistance, while truly absorbing energy (foot-pounds) does not in any manner whatsoever reduce or absorb force. The force required to close a friction draft gear and consequently the force going through the gear to the sills, may be greater or less than a spring draft gear of equal capacity, depending solely upon its compression curve, and not in the slightest degree upon its percentage of absorption. The cushioning value of a gear, therefore, is not measured by absence of recoil, or energy absorption, but solely by its action during the closing period. Whether or not a gear has extensive recoil has nothing to do with its action on compression, or with the force delivered by the gear to the car during its compression."

In summarizing the principles of draft gear action, the following statement was made: "The amount of work absorbed by a gear or the percentage of absorption does not regulate or reduce the force of the first collision, but is important as determining whether shocks will run practically undiminished throughout the train or whether there will be successive reductions in their moments from car to car. The first measure of a draft gear is the amount of energy required to close the gear, this being the sole factor from which to determine for what switching speeds a gear is suitable. This is expressed as 'work done' and has no relation whatsoever to 'work absorbed'."

Operation of draft gears under impact

To make clear the operation of draft gears under impact, it may be desirable to give a brief outline of the action that takes place. Assuming that a moving car strikes a standing car of equal weight, both equipped with spring draft gears, the standing car will start to move as soon as force is set up between the couplers and the moving car will commence to slow down at the same time. At the point of maximum compression, both cars will be moving at the same velocity. As the gears open the velocity of the car which was struck will continue to increase and the velocity of the striking car will continue to decrease. Theoretically, if there was no absorption and the action was frictionless, the striking car would come to rest and the car that was struck would move on with the same velocity that the striking car had at the moment of impact. In actual practice the striking car comes to rest but the car which was struck moves on with about 10 per cent less velocity.

Consider now the action of draft gears, assuming 100 per cent absorption. The action up to the point of maximum draft gear closure would be exactly the same as before but theoretically, after the cars reach the same speed, there would be no force tending to part them and they would move on at uniform velocity.

The arguments in favor of high absorption in a draft gear are, that it will cause a more rapid reduction in the forces transmitted through a train of cars when the car at the end is struck, and it will produce a smaller difference in velocity between cars parting after impact, thus reducing the liability of breaking knuckles if the cars couple.

Action of draft gears in train operation

In most discussions of draft gears the performance in hump yard switching is given first consideration. It is fully as important that a gear should function properly in train operation. It is a well known fact that the friction of bearings at the instant of starting is so high that if the entire train had to be put in motion as a unit, the rating of the locomotive would be greatly reduced. To permit easy starting of trains there should be a slight movement between adjacent cars before the limit of the tractive force of the locomotive is reached. If slack develops between cars it assists in starting but causes severe shocks to be set up. For that reason, the draft gear should have a gradually increasing resistance with an appreciable movement before the resistance becomes greater than the tractive force.

Points on the construction of draft gears

In addition to developing high shock absorbing capacity and permitting easy starting of trains, draft gears should insure smooth and uniform action in compression or release. They should have a minimum rate of wear and should be sturdy enough to withstand repeated heavy impacts. The importance of wear in a draft gear depends upon several factors, including the effect on capacity, reduction of effective travel and development of slack in the gear. Freight cars ordinarily travel over 100 miles in trains between yards where cars are classified. The greatest amount of wear in the draft gear develops not in switching impacts, but in the continual slight movement between cars in train operation.

Comparison of the drop test with actual car impact

The writer was recently called on to answer a number of questions on the comparative value of a 9,000-lb. drop test and the work done in actual car impact. The questions were as follows:

It has been suggested that the velocity at impact under a 9,000-lb. drop test is too great to compare properly with work done in actual car impact, and that it would be possible to determine more accurately car impact velocity at which two gears would just close if the drop weight was increased and the height of the drop decreased so that the velocity at impact of the drop would be more nearly equal to the velocity of the cars at impact?

The little experimental data that is available on the change in the coefficient of friction with changes in speed, indicate that the capacity of a friction draft gear should increase as the weight of the car or drop increased and the speed at impact decreased. A comparison of the result of the drop and car impact tests as given in the report of the U. S. R. A. tests should show the extent to which this affects the performance of draft gears. This data is shown in Table 1. It is to be expected that the work done in the drop would be lowest, double gear runs next, single gear highest.

The comparison shows the following: The ratio of work done in the double gear test run to work done by the same type of gear in the drop test ranges from 71 per cent to 139 per cent, the average being 106 per cent. Seven gears did less work in the car impact test than in the drop test while 10 did more work. The ratio of work done in the single gear closing speed runs to work done in the drop test varies from 79 per cent to 198 per cent, the average being 121 per cent. Four gears did less work in the car impact test than in the drop test while 13 did more work. The ratio of work done in the single gear run to work done in the double gear run varies from 84 per cent to 169 per cent, the average being 114 per cent. Three gears did less work in the single gear run than in the double gear run, while 14 did more work.

The variations in work done in the different tests by some of the gears seems too great to be explained by the change in the coefficient of friction, due to a change in speed of about 50 to 80 per cent. Other factors that might affect the work done are: variations in the capacity of a gear due to atmospheric conditions or condition of friction surfaces; variations in the capacity of different gears of the same type; variations in capacity due to alternate closing in double gear runs, and variations in operation due to position of the gear, vertical or horizontal.

The first factor cannot be checked from the test data. The conditions in the tests were controlled to insure that this factor would be kept to the minimum. The second is illustrated by the drop tests in which the maximum and minimum capacities for the same make of gear vary as much as 47 per cent. The third factor may be quite important; for example, the Sessions K gear gave a closing speed of 3.81 m.p.h. in the single gear run and 4.37 m.p.h. in the double gear run. This slight difference in speed should have little effect on the capacity, but the work done in the single gear test was 45 per cent greater than in the double gear test. Apparently either the weather or the condition of the friction surfaces or alternate closing had a considerable effect on the performance of this gear. There does not seem to be any way to determine from the experimental data the effect which the fourth factor has on the capacity of draft gears. It is probably not as important as some of the other conditions mentioned because this factor would not cause any variation between the single gear and double gear runs, yet the comparison of capacity between these tests shows practically as wide variation as between the drop test and single or double gear car impact tests.

Aside from the factors mentioned above, consideration must be given to the probability of errors in making tests. The drop test as ordinarily conducted, to determine the closing point only, gives results that are practically unaffected by the condition of the apparatus or errors of observation. The records in car impact tests are obtained from several instruments and the results can only be ascertained by plotting a series of derived curves. If the instruments are not accurate or if they are not properly synchronized, errors will occur in the records. The derived curves are subject to errors of judgment. This is particularly true of the velocity curves. In smoothing out the lines drawn by the mechanical differentiating machine, individual judgment is an important factor. The velocity curves for the closing runs are quite steep just before they intersect and a small variation in the slope would make a big difference in the value of the tangent to the curve, which determines the acceleration and the force.

The time-closure curves are probably not entirely reliable. It is not at all likely that a friction gear after starting to close in car impact would begin to open again before maximum closure was reached, or that a gear at the middle of release would again close part way, yet such movements are indicated by some of the curves.

The combination of slight errors in the velocity and time-closure curves may increase or decrease the resistance and the travel of the gears as obtained from these records. Because of the high forces set up near the end of the gear travel, these errors may cause fairly large variations in the work done as determined from the car impact test.

Table I—Results of drop and car impact tests made on 18 representative types of draft gears

Name of gear	Work done in drop test	Work done, single gear, closing speed runs	Work done, single gear run, per cent of work done in drop test	Work done, double gear, speed runs	Work done, double gear run, per cent of work done in drop test	Work done in single gear run, per cent of work done in double gear run
National H-1	23,400	33,633	144	27,184	116	124
Sessions K	14,100	28,017	198	19,366	137	145
Miner A-18-S	14,925	20,117	135	18,716	125	108
Westinghouse NA1	18,750	16,167	66	19,167	102	84
National M-1	14,400	21,300	148	20,000	139	106
Sessions Jumbo	21,075	21,317	101	19,025	90	112
National M-4	16,125	25,000	155	18,466	114	135
Cardwell G-18-A	14,800	16,500	111	17,116	115	96
Cardwell G-25-A	14,175	18,233	129	17,916	126	102
Westinghouse D-3	14,850	15,617	105	14,666	99	107
Gould 175	13,575	14,900	110	13,767	101	108
Murray H-25	12,750	14,800	116	13,900	109	106
Christy	14,700	21,817	148	12,933	88	169
Miner A-2-S	9,900	10,500	106	10,025	101	104
Waugh Plate	10,425	8,283	79	9,100	87	90
Bradford K	8,100	7,833	97	6,833	84	115
Harvey 8x8 springs	7,025	6,650	95	4,991	71	131
Two 8 in. by 8 in. Class G springs	4,350	......	...	4,116	95	...

Weight of drop to correspond with car impact speed

If the weight of the drop was increased to make the speed at impact in the drop test the same as the speed in the closing run of double gear car impact tests, a compromise would have to be made between gears of high and low capacity as shown by the following calculations:

National H-1; Closing speed 5.09 m.p.h. = 7.46 ft. per sec.
Work done in car impact test = 27,184 ft. lb. = 326,000 in. lb.

$$\text{Height of free fall} = \frac{7.46^2}{64.32} = .864 \text{ ft.} = 10.4 \text{ in.}$$

Total fall = 10.4 + 2.5 = 12.9 in.
Weight of drop = 326,000 ÷ 12.9 = 25,300 lb.

Miner A-18-S; Closing speed = 4.46 m.p.h. = 6.55 ft. per sec.
Work done in car impact test = 18,716 ft. lb. = 225,000 in. lb.

$$\text{Height of free fall} = \frac{6.55^2}{64.32} = .688 \text{ ft.} = 8.0 \text{ in.}$$

Total fall = 8.0 + 2.5 = 10.5 in.
Weight of drop = 225,000 ÷ 10.5 = 21,400 lb.

Miner A-2-S; Closing speed = 3.21 m.p.h. = 4.71 ft. per sec.
Work done in car impact test = 10,025 ft. lb. = 120,300 in. lb.

$$\text{Height of free fall} = \frac{4.71^2}{64.32} = .345 \text{ ft.} = 4.14 \text{ in.}$$

Total fall = 4.14 + 2.5 = 6.64 in.
Weight of drop = 120,300 ÷ 6.64 = 18,100 lb.

Two class G springs; Closing speed 1.87 m.p.h. = 2.74 ft. per sec.
Work done in car impact test = 4,116 ft. lb. = 49,500 in. lb.

$$\text{Free fall} = \frac{2.74^2}{64.32} = .116 \text{ ft.} = 1.4 \text{ in.}$$

Total fall = 1.4 + 1.875 = 3.275 in.
Weight of drop = 49,500 ÷ 3.275 = 15,100 lb.

Based on these calculations a weight of about 21,000 lb. would probably be most satisfactory for the drop test, as it would make the speed at impact correspond approximately with the closing speed in car impact tests

for average commercial gears. Considering the many possible causes of variations and errors, most of the differences in performance in the various tests are probably due to other factors than speed and it does not seem logical to expect that the results of drop tests with a weight of 21,000 lb. would be much more satisfactory than tests with a 9,000 lb. weight for determining the amount of work done by the gear in car impact tests.

Assuming that the weight used in the drop test was such that the velocity at impact of drop is approximately equal to the velocity of impact of the cars just sufficient to close two gears, and assuming that sill penetration in car impact is no greater than anvil penetration under the drop, it is interesting to see whether it would be possible to determine from drop test results the velocity of a striking car in car impact at which two gears would just close. During car impact, work is done in overcoming track resistance, in producing strain in the car bodies and usually also in shifting lading, as well as in closing the draft gear. Neglecting the shifting of lading and assuming that strains in the car bodies are equivalent to movement of the anvil in the drop test, the only factor left to consider is track resistance. Referring to Table II, then the kinetic energy in car *A* at closing speed, equals the work done by the draft gear in the drop test multiplied by four plus the work done in overcoming track resistance up to the point of maximum gear closure. The total work done in overcoming track and grade resistance in the car impact tests was in some cases over 3,000 ft. lb., but the greater part of this was grade resistance. For example, the closing speed double gear run of the Session type K shows 2,213 ft. lb. track and grade resistance. Of this only 527 ft. lb. was track resistance. The cars were in contact 10.66 sec., the movement to the point of maximum closure being 4.37 in. for car *A* and 1.40 for car *B*, or a total of 5.77 in. Assuming the resistance is constant, the work done up to the point of maximum closure is $527 \div 21.12 \times 5.77 = 143$ ft. lb. This is negligible by comparison with the 93,820 ft. lb. energy in car *A* at impact.

From this it is evident that if the assumptions made are true and if the work done under the drop with the weight increased would be the same as the work done in car impact, the closing speed in car impact could be determined from the result of the drop test. However, as pointed out in the foregoing paragraphs, there are several conditions that would probably make the last assumption invalid. For example, the extra bracing in the test cars reduces the work done by the car bodies. The work done with ordinary bodies and with other types of cars probably would prove to be an important factor in draft gear operation.

Table II—Data for double gear closing speed test runs

Name of gear	Kinetic energy in car A at impact ft. lb.	One-half kinetic energy in car A at impact ft. lb.	Work done by two draft gears, ft. lb.	Work done by car structures, ft. lb.	Maximum force to close gears, lb.	Yield of two car bodies, in.	Maximum force from time force curves lb.
National H-1	126,300	63,150	54,367	8,783	550,000	.17	810,000
Sessions K	93,820	46,910	38,733	8,177	260,000	.31	400,000
Miner A-18-S	97,800	48,900	37,433	11,467	390,000	.17	680,000
Westinghouse NA-1	85,100	42,550	38,334	4,216	187,000	.16	500,000
National M-1	89,591	44,795	40,000	4,795	404,000	.19	580,000
Sessions Jumbo	90,740	45,370	38,050	7,320	260,000	.17	470,000
National M-4	83,600	41,800	36,933	4,867	159,000	.13	360,000
Cardwell G-18-A	72,930	36,465	34,233	2,232	186,000	.16	300,000
Cardwell G-25-A	80,638	40,318	35,833	4,485	315,000	.14	370,000
Westinghouse D-3	65,437	32,718	29,333	3,385	240,000	.11	280,000
Gould 175	62,295	31,147	27,534	3,613	260,000	.18	410,000
Murray H-25	58,419	29,209	27,800	1,409	210,000	.16	320,000
Christy	68,230	34,115	25,867	8,248	194,000	.17	370,000
Miner A-2-S	50,615	25,307	20,050	5,257	105,000	.27	530,000
Waugh plate	44,866	22,433	18,200	4,200	335,000	.16	335,000
Bradford K	37,927	18,963	13,666	5,297	270,000	.16	340,000
Harvey	26,647	13,323	9,983	3,340	300,000	.12	480,000
G Springs	16,666	8,333	8,233	100	80,000	.01	80,000

It has been suggested that as the ratio of four times the foot pounds capacity of a gear under the drop to the energy in the striking car at the instant of impact increases and approaches unity, protection provided by the gear to the cars also increases on account of a decrease in sill penetration, assuming the car impact velocities for the gears of different designs under comparison to be a constant and the car impact velocities referred to assumed to be just sufficient to close the gears.

In view of the great variations in performance shown in Table I, it would seem that the drop test does not give a reliable indication of the work done in car impact or the results obtained in the car impact tests are not always correct. But even if the work done in both cases were equal, the ratio of four times the foot pounds capacity of one draft gear to the energy in the striking car would not give a fair indication of the protection afforded by the draft gear. It seems fair to assume that the work done in causing yield of the car bodies increases as the maximum force increases and is constant for any given force and that track resistance is negligible. This being the case, the ratio would indicate the percentage of the work done by the draft gears, which would be one minus the percentage of work done by the car bodies. It would decrease fairly rapidly with each increase in the maximum force, but would not give an indication of the magnitude of the force, as this would vary, depending on the travel of the gear and the form of the force-closure curve.

If all the gears to be compared had the same travel, this ratio might be useful as a check on the maximum force developed by the draft gear in car impact, but even so it would not be of much value in rating the gears. Car sills and draft attachments are designed for a maximum force of 500,000 lb. and a draft gear that sets up a maximum force of 200,000 lb. does not necessarily give better protection to the car than one which goes to 500,000 lb. The argument may be advanced that some cars are not designed for a 500,000-lb. load; however, they will surely be subjected to much greater forces in oversolid impacts and the limitation of forces below 500,000 lb. does not seem to have any special advantage.

If the ratio of work done under the drop to the energy in the striking car at the instant of impact was to be used to measure the protection afforded by the draft gear, it would be necessary to work closer to the actual closing speed in car impact tests. For example, in one of the double gear closing speed runs with a gear which closed at 390,000 lb., see Table II, the work done by the car structures was 11,467 ft. lb., while another gear which

closed at 404,000 lb. shows only 4,795 ft. lb. work done by the car structures. From tests run with solid blocks in place of draft gears, it is found that the work done by the car structure under a force of 400,000 lb. is 4,300 ft. lb. This would, of course, affect the ratio and a slight oversolid speed would make the gear show up unfavorably in this comparison.

The term draft gear capacity as now used has various meanings. It would be desirable to have a standard definition, so that draft gear capacity would represent the capacity of the gear to protect the car. This would necessarily take into account several characteristics of the gear. Probably the best plan would be to rate the gears by a method similar to that given in the report of the U. S. R. A. tests under the heading, "Grading of commercial gears." The disadvantage of this plan lies in the fact that no two persons are likely to select the same characteristics and give them the same relative weight. In general the method proposed in the report is excellent, but it seems to be based too largely on the results of laboratory tests.

As a basis for the consideration of this matter there are listed below some characteristics of draft gears which observation has shown to have a marked effect on performance with the relative values which the writer would assign to them:

A—Capacity under various conditions representative of actual service	40 points
B—Rate of wear and effect of wear on capacity	20 points
C—Oversolid sturdiness	20 points
D—Absorption	10 points
E—General operation	10 points

A—Capacity to absorb shocks in car impact is without doubt the most important factor affecting the performance of draft gears. Car impact tests as ordinarily conducted are indicative of the results that may be expected under favorable conditions, but it seems equally important to know what results will be obtained if the gear is wet, covered with frost or rusted. As a basis for rating the capacity of a draft gear, the writer would suggest the average of three drop tests: one, under ordinary fair weather conditions; two, a test made while the gear is still wet after being immersed in water for a short time; three, a test made with coated friction surfaces.

B—A draft gear should not only give high capacity under all conditions of service, but it should also retain its capacity over a reasonably long period of service. A repeated impact test with varying drops below the closing point should give valuable information as to the performance to be expected from draft gears after they have been in operation for some time.

C—The standards for draft gear applications established by the A. R. A., with not less than ¼-in. clearance between the coupler horn and the striking casting, make sturdiness a very important factor in draft gear performance. The destructive drop test is probably the best method of determining the ability of any gear to withstand oversolid impacts.

D—The importance of high absorption has probably been over-emphasized in many cases. The yielding of the car structures and the movement of the cars along the track both absorb a considerable amount of energy in heavy impacts. No absorption is required in taking up light impacts and 50 per cent absorption at closing in car impact appears to be ample to prevent destructive shocks from being transmitted to succeeding cars. Some draft gears show a tendency to stick partly or fully closed. This is a serious defect and should be avoided under all conditions even if in doing so it becomes necessary to decrease the percentage of absorption.

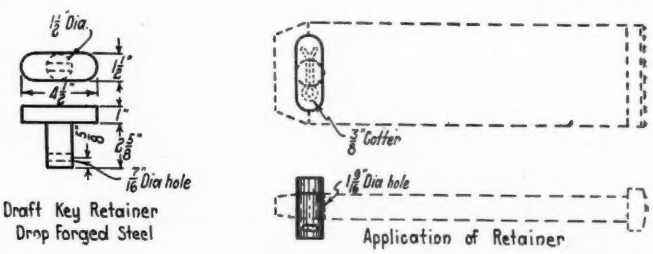
E—This would cover other features that affect the performance of the gear such as smoothness of action, absence of sticking, operation when draft lugs are out of alinement, having a creeping sheet under fluctuating car load, etc.

Some of the factors which have been suggested as the basis for rating draft gears cannot well be determined from laboratory tests. While it is realized that it would be desirable to have gears rated on the basis of tests that can be made easily and quickly, the lack of agreement between various types of tests indicates that there is no way to determine the true merit of draft gears except trials in actual service.

A. R. A. adopts draft key retainer

IT is believed that derailments on American railroads will be appreciably reduced as the result of the perfection by the Chicago, Milwaukee & St. Paul of a non-slip drawbar key cotter pin. The pin has been accepted by the American Railway Association and K. F. Nystrom, engineer of rolling stock of the Milwaukee, its designer, was voted a substantial reward. Prompt action by the railroads in adopting the pin as standard is expected. This new pin forms a positive lock which prevents the coupler separating from the car.

Its widespread use, it is understood, will eliminate one of the chief causes of derailments. A careful check of derailments caused by old style cotter pins shows that at least 100 such accidents occur annually. Thus, according to the report of the American Railway Association, "failure of these cotters results in a serious condition, as



The Nystrom draft key retainer

there is nothing to prevent the draft key from working out of place. When this occurs, the coupler is pulled out and falls on the track, frequently causing derailments."

A special committee of the association recently made an exhaustive investigation of derailments on four of the country's large rail systems in widely separated sections. One road reported no less than eight derailments in a period of 14 months directly resulting from drawbar key cotter pins shearing off or becoming lost. The other roads reported numerous instances where broken or missing cotter pins had become a menace. The report further states:

"The inadequacy of the cotters in general use is further indicated by the fact that many roads are applying to their own cars other devices to retain the draft keys in place. The greater number of these special draft key retainers, while effective, are in some cases thought to be unnecessarily expensive and difficult of application to existing cars."

The American Railway Association, by formally adopting the Nystrom pin, makes it available to manufacture by all railroads without any patent or royalty charges.

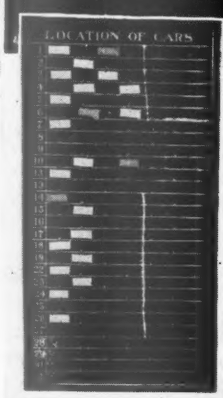
Fig. 1—The cabinet shop. Fig. 2—Interior view of one of the repair shops. Fig. 3—The wash shop. Fig. 4—Tin and pipe shops. Fig. 5—The wood mill. Fig. 6—Table for cleaning window panes. Fig. 7—Cleaning seat cushions. Fig. 8—Truck for hauling baggage car doors. Fig. 9—Heating glue in the cabinet shop.

View of the Kingsland Coach Shops of the Delaware, Lackawanna & Western—The shipping tracks are shown at the right of the illustration, the incoming track, No. 13, is shown at the left

Maintaining passenger equipment on the D. L. & W.

Systematic scheduling of repairs facilitates production at the Kingsland coach shops

THE efficient handling of repairs to passenger equipment is an important factor on any railroad that does as large a volume of through and local passenger business as the Delaware, Lackawanna & Western. This road, the eastern rail terminus of which is at Hoboken, N. J., handles a large commuter traffic from New York City to different towns and cities in Northern New Jersey. A total of 194 commuter trains are run out of this terminal each day of the week, except Saturday and Sunday. These trains are additional to a number of through trains. This large volume of traffic running out of Hoboken makes it essential that the coach repair shops be located at some point convenient to this terminus.



Above—Shop schedule board; Left—Board showing the location of each car being repaired in the shop

Kingsland, N. J., is located on the Boonton line about eight miles west of Hoboken. The coach repair shops at that point have a capacity of 50 general coach repairs a month. At the present time it is being operated with a force of approximately 195 men, working five days a week, with an output of about 32 cars per month. The Kingsland coach shops handle all the general and ordinary class repairs for the entire system, in addition to a large number of minor repairs not made at the light repair shop at Hoboken.

Referring to the drawing, the coach shop consists of a large building 170 ft. wide at the south end, 220 ft. 8 in. wide at the north end and 660 ft. 1½ in. long, containing the wash and repair shops; a building 268 ft. 4 in. by 40 ft. containing the general foreman's office, paint stock room, buffing room and lavatory; a building 300 ft. by 70 ft. which contains the upholstering and cabinet shops, washing and varnishing rooms; a finished lumber shed, 256 ft. by 60 ft.; and a wood mill which is 264 ft. by 70 ft. All the buildings are of brick construction. In addition to the buildings mentioned, there is a power plant which furnishes power and heat to the coach shop buildings and also to a 21-stall locomotive shop of rectangular construction, located on the west side of the transfer table, opposite the repair and wash shops. A kiln for drying lumber is located directly in the rear of the power house. The storehouse, which is located east of the general foreman's office, furnishes supplies both to the coach shops and the locomotive shop.

Progressive system of repairs is followed throughout

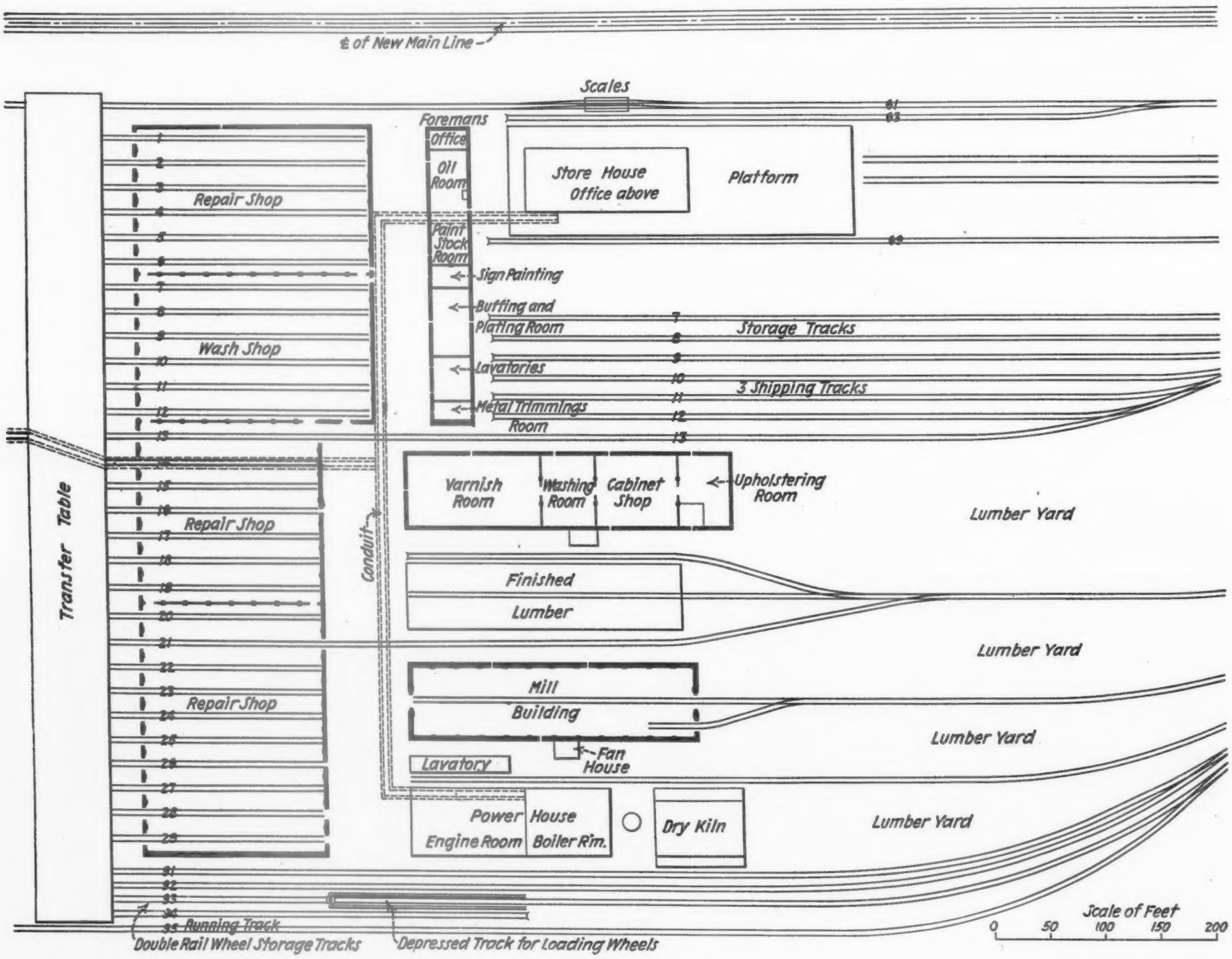
Cars to be repaired are brought from Hoboken to Kingsland and placed on the shipping tracks, tracks 7 to 12, inclusive. A train from Hoboken hauls out cars to be shopped in the morning and makes the return trip with finished cars at the close of working hours in the evening. It is used by many of the employees at the Kingsland shops for commuting to and from work, addi-

tioned cars being included in the train for this purpose.

The general foreman notifies the master mechanic at Kingsland the numbers of all cars arriving at the shops. Cars to be repaired are switched from the shipping tracks, when scheduled in, to track 13, which runs past the upholstering shop and varnish room building, through the repair shop to the transfer table. As soon as a car arrives on the shipping tracks at Kingsland, it is inspected by the car and paint foremen for the class of repairs it is to receive. In addition to this inspection, the general foreman at Kingsland receives a report showing the class and car number of cars that have been in service 18 months or over. This report, together with the inspection, determines whether the car is to receive general or ordinary repairs. General repairs include burning off the paint, applying new floor, roof, etc. In case of wooden cars, the longitudinal sills are renewed. Ordinary repairs include stripping the cars of all trimmings, turning the wheels and repainting. Minor repairs, the larger proportion of which are made at Hoboken, usually include repairs to the draft gear, couplers, running gear, etc.

A schedule board, shown in one of the illustrations, is maintained in the general foreman's office. As soon as the class of repairs for each car has been determined, the car number is marked up on the board together with the date in and the date out of the shop. A column showing the cars in storage at Kingsland is also shown on the board. A copy of the information on the schedule board is also maintained on a small bulletin board centrally located in the repair shop. This board is maintained for the information of the supervisors and men who work in that building.

A second board is also kept in the general foreman's office which shows the location of each car in the shop. This board is shown in the same illustration as the schedule board. The numbers shown in the left hand columns are track numbers. Hooks are placed in a row opposite each track number equal in number to the car capacity of that track. Tin tags in which a ticket can be inserted on which is written the number of a car, are hung on the hooks according to the location of each car on the track. When a car is moved from one track to another, the clerk in the general foreman's office is notified and the tag is moved to show the new location of the car. Knowing the location of each car in the shop saves considerable time on the part of the general foreman and his staff in locating a car and also indicates to some extent the progress of the work on a car.



Drawing showing the location of the repair tracks and buildings of the Kingsland coach shops of the Delaware, Lackawanna & Western

The scheduling of all cars through the shop is planned by the general foreman. After a car has been scheduled the foremen are notified by letter, of the cars that are to be released during the month. The master mechanic at Kingsland is also notified by letter about the middle of the month of the kind and number of cars that will be released for service during that month. In addition to

keeping the various officers advised of the progress of the work at the Kingsland coach shops, a letter is also sent out showing the schedule of repairs to be made on special service cars, such as buffet, observation cars, etc., as soon as the planning of the program for repairs on such cars has been completed. The master car builder at Scranton, Pa., receives a daily report of all cars going through the shops, showing the dates in and out, the class of repairs each car is receiving and the cars in storage.

The upholstering shop

Each car, as it starts through the shop is spotted first in front of the upholstering shop. The foreman in charge of the upholstering shop makes a preliminary inspection of the seats, window curtains, etc., to ascertain the amount of upholstering work the car will require. The seat cushions and backs, window curtains, etc., are then removed from the car and taken into the upholstering shop. All the equipment taken from one car is routed through the shop together and is not mixed with equipment taken from other cars.

Each back and seat is inspected by a man who works at a bench located at the end of the storage racks shown in one of the illustrations, nearest the entrance through which they are brought in. Each cushion is given a careful inspection by this inspector, who also makes any minor repairs, such as sewing up small rips, etc. If the inspector thinks that a back or seat should be recovered, he marks it for the attention of the upholstering shop foreman. The foreman checks up on the life of the upholstering, etc., from his records to ascertain the wearing qualities of the material. With this system of checking he is able to make a fairly accurate estimate of the wearing qualities of various kinds of upholstering material.

Seats not to be recovered are routed to the wash room where they are cleaned with soap and hot water. The device used for cleaning seat cushions and backs is shown in one of the illustrations. A stiff fibre brush is revolved by a belt on a flanged pulley driven from a line shaft. As shown in the illustration, provision, is made for moving the table in any direction desired. A hair picking machine which has an output of about 50 lb. per hour is also located in the upholstering shop wash room. This machine can also be used for cleaning cotton batten by replacing the coarse teeth used for cleaning hair with finer teeth.

All the upholstering work for the entire system is handled at Kingsland. The upholstering shop also cleans and renews window shades, makes all the vestibule curtains for cars going through the shop, cab curtains for all locomotives on the Morris and Essex division, mattresses for cabooses and camp cars. From five to six cars are equipped with new window shades each month and about 3,000 side and back locomotive cab curtains are made each year. Cab curtain requirements for the following winter are estimated the first of each summer. The upholstering shop employs 11 men, including seven mechanics, two apprentices, one dyer and one helper.

The upholstering shop is provided with racks where the backs and seats taken from each individual car are stored together until needed

Interior view of the wash room—Suitable racks are provided for the storage of different kinds of trimmings and equipment

Seats or backs to be renewed are stripped down to the frames, which are sent to the cabinet shop for repairs. The hair used for stuffing is reclaimed but the old plush is sold as rags. The springs for each seat are kept together and assembled in the same seat from which they were removed. All backs and seats, if scheduled for renewal, are double stuffed and hand stitched. Only hair is used for stuffing. One mechanic performs all the work

on a back or seat; the various operations are not divided among a number of specialists.

The wash room and cabinet shop

After the seats, backs, window curtains, etc., have been removed at the upholstering shop, the car is then moved along track 13 to the wash room. At this spot the windows, screens, doors and other trimmings are removed and taken to the wash room. Both the wash and varnish rooms, referring to one of the drawings, are under the supervision of the same foreman. All the trimmings are washed with soap and hot water; any dirt that will not come off by ordinary methods is removed by means of fine pumice stone and a scrubbing brush.

All wooden and metal parts are routed from the wash room to the cabinet shop where each sash, stop, catch, etc., is inspected, repaired or renewed. Brass trimmings requiring buffing or plating are placed in a box and taken to the buffing shop. This shop is equipped with three buffing machines, a dryer and vats for washing, oxidizing and plating. All brass has an oxidized finish. Brass parts are placed in a lye vat and boiled for an hour or more. They are next dipped in a bath of nitric acid, then rinsed, washed in hot water and finally placed in an oxidizing solution. The brass is then polished, dipped in lacquer and hung in the dryer. It requires about a half day to do this work on the brass trimmings from one car. When ready to be placed in service they are taken to the repair shop and applied to the car according to schedule.

The cabinet shop can handle two sets of trimmings at one time, the working force being divided into two gangs. The work in this shop is specialized, each man performing a certain kind of work, according to requirements. One man, for example, builds all the doors for baggage cars. This shop is provided with a band saw, a rip and cross cut saw, a hand planer, and a mortiser and borer.

The various parts of any one of a variety of doors are cut to fit in the wood mill. Square rods about 2 in. by 2 in., marked for the various panel openings and other piece sizes, are kept on a rack in the wood mill. All the information necessary to make each size door is marked on one of these rods. The rod is then shellaced to prevent the markings from becoming smeared or rubbed off.

Co-ordination between the cabinet shop, wash room and varnish room is obtained by means of a progress chart placed on a bulletin board located in the wash room. This chart is primarily for the information of the general foreman, cabinet shop foreman, and the wash room foreman in checking up the movement of trimmings to and from the wash room, cabinet shop, or varnish room. As stated in a preceeding paragraph, all the trimmings for each car are kept together while being routed through the shop. The chart shows the number of the car from which the trimmings are taken, the date in the wash room, the date in the cabinet shop and the date in the varnish room. Notations of delays occurring in the handling of trimmings between these three departments are made on the back of the chart which is filed for future reference.

Varnish room is well equipped with racks and benches

Upon completion of the repair work on the trimmings in the cabinet shop, the entire set from one car is taken to the varnish room. As shown in the illustrations of the interior of the varnish room, this department is well equipped with racks, tables and benches for finishing various kinds of passenger car trimmings. Adjustable racks are provided for different widths of window sashes and parts of similar shape. Each rack partition is hung on rollers so that it may be moved to suit the width of the sash. The edges of the sash supports are beveled so that only a minimum of wet varnish is rubbed when a sash is placed in the rack. The supports are spaced $2\frac{1}{2}$ in. center to center.

Shown in one of the illustrations is a table provided with sloping supports for holding car windows while the glass is being cleaned. Each support is provided with pins which fit in $\frac{1}{2}$-in. holes bored in the table top. The pin holes are staggered in order to provide closer spacing adjustment between the two supports. The supports are about 24 in. long, being 4 in. high at the rear and 2 in. at the front. Each support is flanged to hold the sash in position. The part on which the sash rests is beveled away from the flange to prevent injury to the varnished

Looking down the center aisle of the varnish room—Adjustable racks for coach windows are shown on the right, revolving fixtures for varnishing sashes are shown on each of the four tables, and a truck for transporting windows is shown standing in the aisle

surface. The supports and the table top are covered with tin which provides a surface that is quite easily cleaned.

The view showing the interior of the varnish room shows in addition to the sash racks described in the preceding paragraph, a convenient fixture for painting and varnishing windows and a chart for moving car windows between the various departments. The fixture for varnishing car windows consists of a wooden base, 16 in. by 16 in., covered with tin, and a revolving top 10 in. in diameter. The top is pivoted to the case at the center and is provided with four small casters which run on the base. The castors give the top stability. The window pane rests on four rubber stops screwed into the top, which is also covered with tin. The height from the table top to the top of the fixture is 5½ in. The car window cart is constructed as shown in the illustration, seperate spaces being provided for 18 windows. The top frame secured to the end frame can be adjusted to suit the sash by a pin inserted in holes bored in the end pieces of the frame.

Cars are repaired and painted on one spot

As soon as the work of stripping the car has been completed at the wash room, the car is then moved through the repair shop on track 13 to the transfer table, by which it is moved to any one of the tracks 7 to 11, inclusive. (Track 12 is used for repairing locomotive tenders from the enginehouse.) Here the car body and trucks are washed. The wash shop is adequately equipped with drains for carrying off the water and dirt. The cars are washed inside and out with a solution of soap and cold water and the trucks are washed with a lye solution. Upon completion of the work of washing, the car is taken, via the transfer table, to a vacant spot in any one of the three repair shops. No other movement of the car is made until it is ready to go to the shipping tracks, tracks 10, 11 or 12 for final trimming.

Upon arrival of the car on the repair track, the body is jacked up, placed on horses and the trucks moved out for repairs and testing. Brake cylinders are cleaned on the car.

The type of scaffolding shown in a number of the interior views of the repair and wash shops is used throughout. The upright posts of the scaffolding are 2½-in. by 4-in. channels, 10 ft. in height. The floor of the scaffold consists of a plank 2¾ in. thick by 15 in. wide, which rests on a malleable iron bracket, flanged ½ in. to fit over the flange of the channel post. This bracket is ⅜ in. thick and has a supporting arm 12 in.

Interior view of one of the repair shops—The window cart shown standing in the aisle has just been brought from the varnish room

long and a bearing arm of 12 in. resting against the channel post. The planks are prevented from sagging by ¾-in. truss rods secured to the planks at each end by means of a 2-in. by 2-in. angle. The horizontal flange of the angle is bolted to the plank. Through the vertical flange is a 1⅛-in. hole, through which the rod is secured by a nut on the end. A cast iron block, 4 in. by 12 in. by 16 in., is used as a counter weight to facilitate ad-

A travelling hoist is used for handling lumber in the yard

at each end of the car. The inside finishing is started as soon as the car is washed, regardless of whether or not the car has been moved to the repair track. A gang of two men do the inside work and a gang of from two to three men do the outside work. The outside work is carried along independently of the progress of the work inside the car. Truck repairs are handled by five gangs of four men each, all of whom are under one foreman. When necessary, truck parts are repaired in the welding department, including such work as building up truck pedestal jaws, etc. Air brake repairs are handled by a pipe gang of three men. Triple valves, feed valves, check valves, etc., are sent to the Keyser Valley, Pa., shops justing the height of the scaffold. The bracket is secured in place by a ½-in. pin inserted through a hole in the bracket and channel post. Each post is stepped in a concrete base.

The pipe, air brake, tin and welding shops are located in the repair shop between tracks 13 and 16 and are all under the supervision of one foreman. These departments are grouped around the tool room cage, shown in one of the illustrations. The tool room is in charge of one man and all tools are issued by the check system. This location of the tool room is especially advantageous owing to the fact that the men working in the pipe, air brake and tin gangs require a considerable amount of

tool service. The pipe shop and tool room are provided with the following machine tools:

Double head bolt threader
Pipe cutter
Rip saw
Grind stone
Emery wheel
Small drill press
Large drill press

The carpenters and steel car men repair the car body at the same time the trucks and air brake equipment are being repaired. As soon as the body repairs are completed, the painters start work. Steel cars in for general repairs, are treated by the painters as follows. The exterior of body of the car is cleaned off with a paint and varnish remover. After the surface has been thoroughly cleaned from grease, etc., it is given a coat of steel car primer, followed by a coat of steel car surface, 48 hours being allowed between coats. Twenty-four hours after applying the surfacer, all rough or uneven parts are knifed in with putty and a surfacing composition which is allowed to dry for 24 hours. This is followed with two coats of steel car surfacer and one coat of guide coat, 24 hours being allowed between coats. The surface is then rubbed down to a smooth finish with block stone, or by sandpapering. Two coats of color are then applied, allowing 24 hours between each coat, the car being lettered the following day. The lettering is protected with three coats of finishing varnish, allowing from 48 to 72 hours between coats for drying, depending upon conditions.

The welding shop is centrally located in the repair shop which makes it easy of access from all departments

All interior steel finish is cleaned off with a paint and varnish remover. After being thoroughly scraped and cleaned the surface is primed with steel car primer, which is followed with sufficient coats of surfacer. When the surface has been rubbed smooth, one coat of flat color is applied, which is allowed 24 hours for drying. This is followed by the application of two coats of mahogany enamel, allowing 48 hours between coats for drying. In the case of steel cars, such as diners, buffet, private cars, etc., the interior finish is treated somewhat differently in that after the surfacer has been rubbed smooth, two coats of mahogany ground color are applied, allowing 24 hours between coats. The finish is then grained in imitation of mahogany, oil colors being used. When thoroughly dry, three coats of inside rubbing varnish are applied, 48 hours being allowed between coats for drying. After standing for three days, the varnished surface is rubbed down to a dull finish for the purpose of removing all trace of dirt or grit, and after being allowed to stand for at least 48 hours to sweat out, the entire rubbed surface is then polished, the secret of satisfactory polishing being obtained by doing a first-class job of rubbing.

Trimmings follow the car to the repair shop

During the time that the car is being repaired and painted in the repair shop, the trimmings are being completed in the cabinet and varnish departments. The trimmings are scheduled so that they will be ready to go on the car at the time the painters are finished on the car body. This system of careful scheduling, which is, of course, governed by the output capacity of the different departments, permits the routing of the trimmings direct from the varnish room to the car in the repair shop at the time the car is ready to receive them.

Supervisory staff of the Kingsland coach shops

This step is the longest one taken in the routing of the trimmings through the shop. Special trucks are provided for handling windows, doors and other material. End doors are carried on baggage trucks in the manner shown in one of the illustrations. One end of the door rests on a padded block bolted to the truck while the edge of the opposite end of the door rests on the truck itself. This method of handling reduces the liability of injuring the finish to a minimum.

Upon the completion of the work of applying the trimmings, the car is moved to the shipping tracks, via track 61, where the seat backs and cushions are applied. This operation completes the work of repairs on the car which is then marked O.K. for service and is taken to Hoboken on the evening trip of the work train.

Handling material

The storehouse carries stock for both the coach shop and the enginehouse. An Elwell-Parker lift truck is used for handling material from the storehouse to the coach shop as well as for handling various kinds of material between the various departments and from the yards. Material is requisitioned by the foreman in charge who issues a material ticket to the man in charge of the truck. The truck man goes to the storehouse, gets the material ordered and delivers it to the proper department. A number of skids are provided for the various departments on which castings, forgings and other heavy material is loaded to be handled by the lift truck.

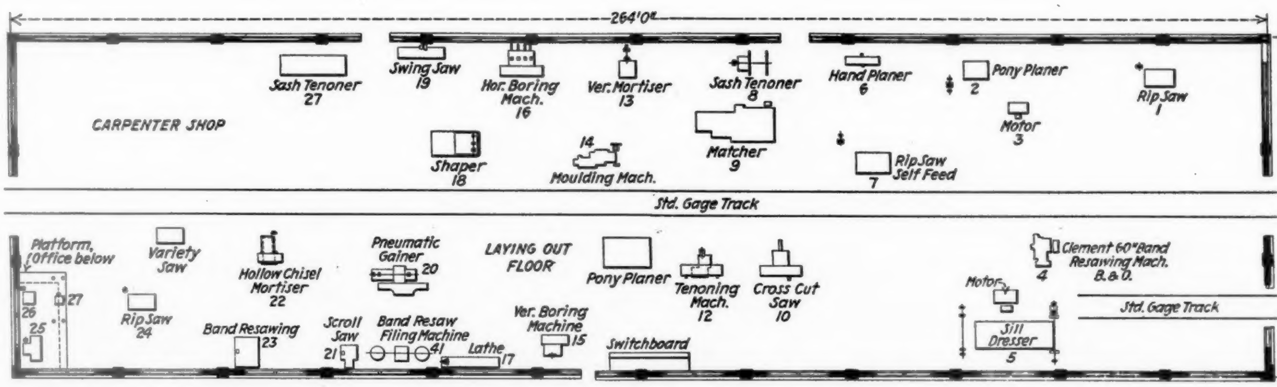
The electric truck is also used for transporting finished parts from the wood mill to the cabinet and repair shops. The wood mill is well equipped, the list of machine tools and their location being shown in one of the drawings. It is equipped with a vacuum system for moving shavings to the power house where the shavings are burned as fuel. An average of 16 men are employed in the wood mill, but only about 50 per cent of their time is devoted to work for the coach shop. A considerable amount of work is handled in the wood mill for other shops on the D. L. & W. and also for the signal and the maintenance of way departments. Following is a list of the machines installed in the wood mill, the number given in the left hand column refers to the numbers on the drawing showing the location in the mill.

1—Rip saw large
2—Pony planer
3—Sill dresser small
4—Band resawing machine
5—Sill dresser large
6—Hand planer
7—Self feed rip saw
8—Sash tenoning machine
9—Matcher
10—Cross cut saw
11—Pony planer
12—Tenoning machine
13—Vertical hollow chisel mortiser
14—Moulding machine
15—Four-spindle vertical boring machine
16—Four-spindle horizontal boring machine
17—30-in. wood turning lathe
18—Shaper
19—Swing saw
20—Pneumatic gainer
21—Scroll saw
22—Hollow chisel mortiser
23—Band saw
24—Small rip saw
25—Knife grinder
26—Gumming machine
27—Band saw filing and setting machine
28—Universal rip saw
29 and 30—Sash tenoning machine
31—Turning lathe
33—Grind stone
34—Band resaw gummer
35—Band resaw roller and stretcher
36—Belt lacing machine
38—Drill grinder
39—Double grinder No. 2
41—Band resaw filing machine

Conclusion

The feature in the operation of the Kingsland coach shops is undoubtedly the complete co-ordination obtained between the various departments. This is accomplished to a large extent through careful scheduling of the work through the shop. The supervisory staff of 19 men get together for a meeting in the general foreman's office each Saturday morning at which time various problems pertaining to the management of the shops are discussed. All the work done in the shops is performed on a piece work basis, the rates being established by a representative of the head of the car department.

All the buildings are of semi-fire proof construction, protection being provided by means of an efficient fire fighting organization. Hose reels are located at strategic points throughout the shop and drills are conducted frequently. All the buildings are provided with fire extinguishers and provision has also been made for allowing live steam to enter a building in case of fire. A box with a glass front, painted red, is attached to the steam line in a convenient location outside of each building. In case of fire, the glass is broken and a valve is turned which permits the steam to escape into the building.



Drawing showing the location of machine tools and shop equipment in the wood mill

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Coupler rejects a source of low-phosphorus steel scrap

A PHOTOGRAPH showing scrap couplers at the plant of the Falk Corporation, Milwaukee, Wis., appeared on page 686 of the November *Railway Mechanical Engineer*. Contrary to the impression created by the caption which accompanied the photograph, only a portion of these couplers are scrapped by the railway, due to obsolescense, wrecks and wear. The remainder are misruns and manufacturers' rejects purchased from the plants of coupler manufacturers, as a source of low phosphorus steel scrap.

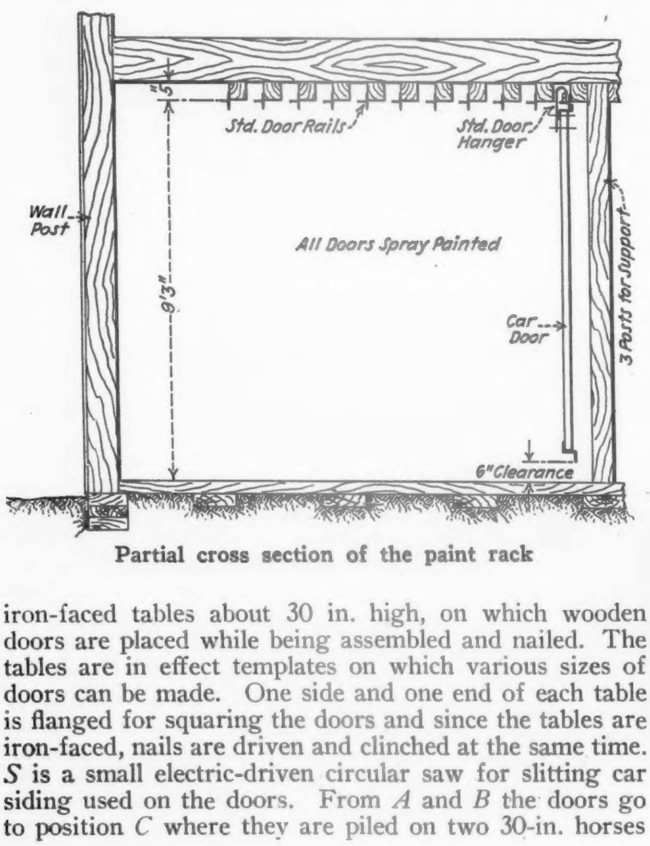
THE MISSOURI-KANSAS-TEXAS has granted an increase in wages of two cents an hour to locomotive and car shop and enginehouse employees, the two-cent advance applying generally with the exception of two or three minor classes to which only a one-cent increase was applied.

A well organized car door shop

The volume of box car repair and rebuilding work done at the Chicago, Milwaukee & St. Paul car shops, South Tacoma, Wash., involves the construction of a large number of standard A.R.A box car doors, an important detail which is handled in a separate small shop building especially laid out and equipped for the work. Lumber used in construction of the doors comes in at one end of the shop, is assembled, trimmed, painted and handled through the shop in an orderly manner without lost motion or back travel. Four men, working in pairs, manufacture the wooden doors, and four other men, also working in pairs, apply the fittings. Another man spray-paints the doors. This force turns out an average of 16 doors in eight hours.

Doors are suspended from standard door rails for painting

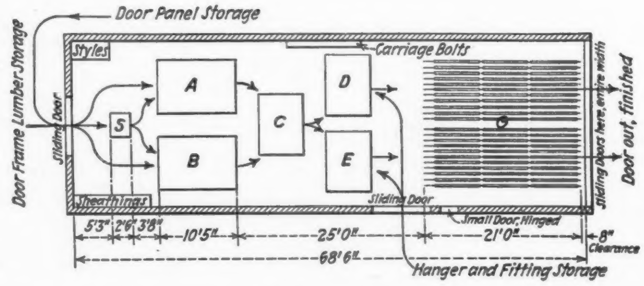
Referring to the shop floor plan, *A* and *B* are two iron-faced tables about 30 in. high, on which wooden doors are placed while being assembled and nailed. The tables are in effect templates on which various sizes of doors can be made. One side and one end of each table is flanged for squaring the doors and since the tables are iron-faced, nails are driven and clinched at the same time. *S* is a small electric-driven circular saw for slitting car siding used on the doors. From *A* and *B* the doors go to position *C* where they are piled on two 30-in. horses for the application of Lucas cement on the edges. From *C* the doors go to positions *D* and *E* where they are supported at each position on two 30-in. horses for trimming. The hangers and fittings are brought in from a storage conveniently located just outside the sliding shop door, and the use of pneumatic drills and electrically-driven nut tighteners greatly facilitates this work of trimming. All countersunk bolt holes are also bored with the pneumatic machines.



Partial cross section of the paint rack

From positions *D* and *E* the doors go to position *G* where they are suspended from standard box car door rails high enough to allow 6 in. clearance above the floor. This door storage has a capacity for 66 doors, three on each rail, and it is at this position that the painting is done. As soon as the doors are dry they are taken out of this end of the shop through large sliding doors, loaded on a truck and distributed as needed in the car shop and car repair yard.

One car man and helper work at each of the two tables, *A* and *B*, completing the woodwork on two box car doors in an average of one hour. One car man and one helper also work at each of the stations *D* and *E*, trimming two doors in one-half hour. The trimmers also take care of additional and special door work that may come up. The painting, which is done with a spray gun by one man, takes approximately 15 min. for each door. All wood material, iron trimmings, bolts, etc., are conveniently located, the racks being kept full by the stores department force so that men who work on the doors lose no time waiting for or getting material. Sheathing used on these doors comes cut in the proper length and styles are milled in the wood mill.



Plan of the Tacoma, Wash., door shop of the C. M. & St. P.

Collector pipes and receiver from which mill room shavings are blown to the power house for burning

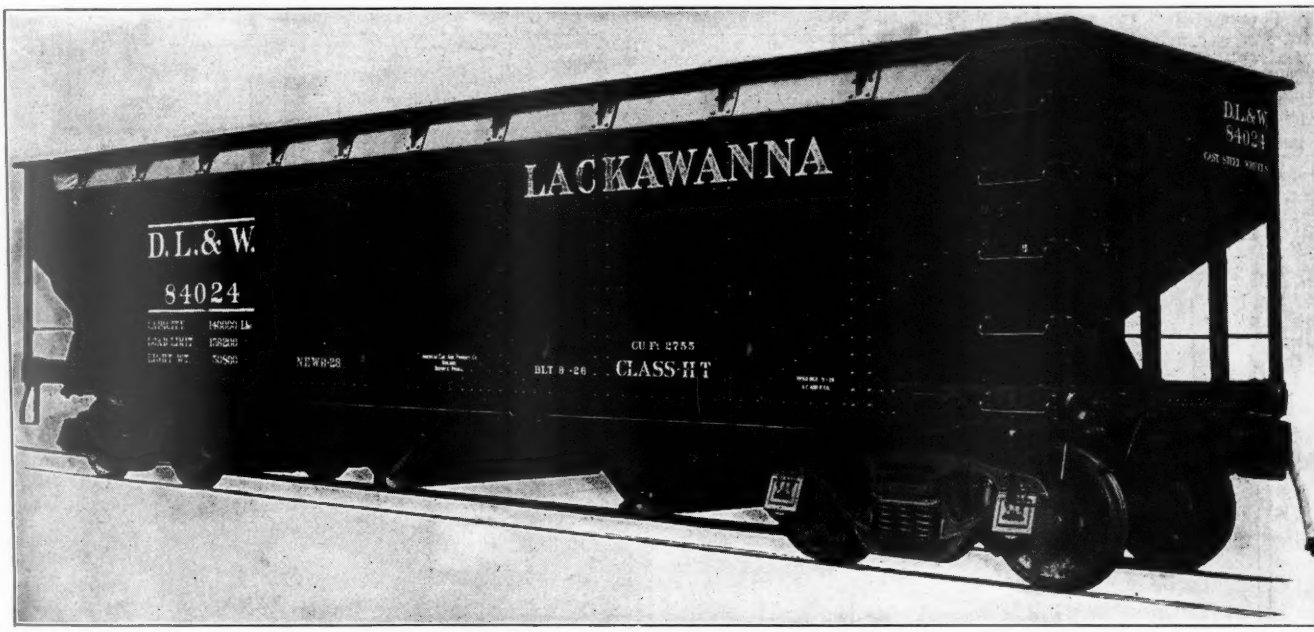
Lackawanna installs 70-ton three-hopper steel cars

Many parts standardized and interchangeable—Loading increased by locating stakes inside

THE Delaware, Lackawanna & Western has recently placed in service 400 70-ton hopper-gondola cars which were built by the American Car & Foundry Company at its Berwick, Pa., plant. These are the first cars of this capacity and of the three-hopper type to be used by the Lackawanna and they were built to replace an equal number of 40-ton steel and wood coal cars. These cars are particularly designed so as to be suitable for handling the very small sizes of hard coal with a minimum of loss from sifting through openings in the car.

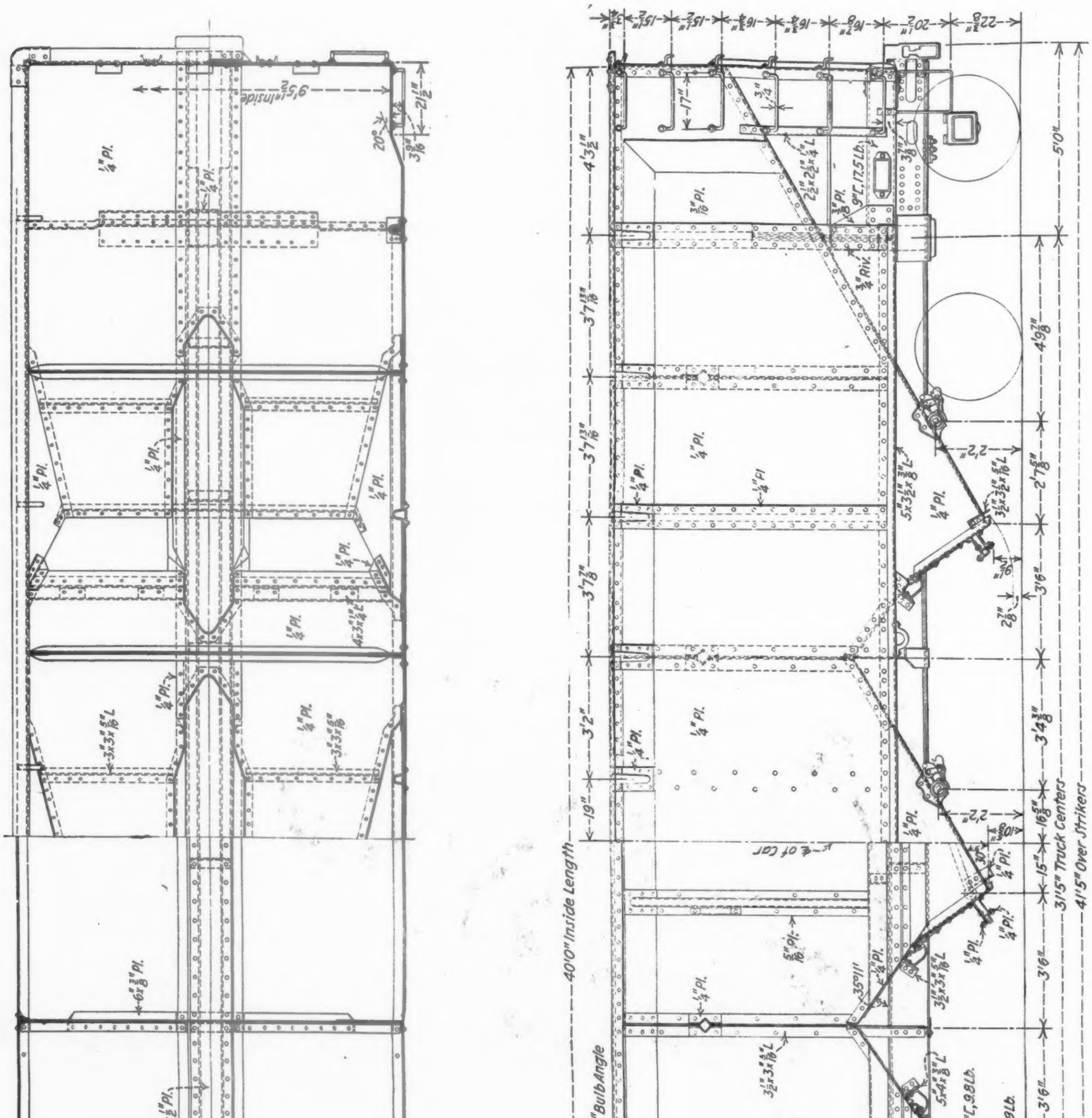
The total length of the cars over buffers is 41 ft. 5 in. the extreme width 10 ft. 2¾ in. and the height from rail to top of sides 10 ft. 8 in. The capacity, level full, is 2,755 cu. ft. and the light weight 50,800 lb. Three double hoppers are provided, with extra large door openings to facilitate easy and rapid discharge of the lading. The details of the hopper, such as the side and center hopper sheets, stiffeners, door spreaders and hopper doors are standardized and interchangeable, thus minimizing the number of parts required for repair work. The hopper doors are of corrugated steel, each set operating independently. Increased loading capacity over the conventional type of hopper car is provided by arranging the stakes on the inside of the side sheets instead of on the outside. There are 10 pressed steel stakes on each side of the car, two of which are secured to the center construction by means of deep gusset plates to prevent bulging of the sides. The sides are further reinforced by four pressed steel cross ties placed at the top of the sides and properly spaced to give uniform stiffness. This construction is shown in the drawing.

The under-frame is of the built-up type with two center sills composed of A. R. A. standard 12-in. special rolled channels weighing 40.3 lb. per ft. extending the entire length of the car, with a ½-in. by 12¾-in. top cover plate. The ends of the channel are coped away to receive the buffer attachments together with a Union coupler centering device. There are seven pan-shaped ¼ in. pressed fillers, and one saddle of ¼-in. pressed steel located under each longitudinal ridge sheet. The body bolsters are built up of plate and angle construction. The bolster and side connection angles extend into the car. Diagonal braces of 5-in. by 3½-in. by ⅜-in. angles are connected to the center sills and bolsters by $\frac{5}{16}$-in. gusset plates.



70-ton three-hopper steel car for the Delaware, Lackawanna & Western built by the American Car & Foundry Company for handling small sizes of hard coal

The top side angle is a ⅝-in. by 3½-in. by ⅜-in. bulb angle running the entire length of the car. The bottom flange angle at the sides is 5 in. by 3½ in. by ⅜ in. and extends from bolster to bolster. The side sheets, with the exception of those at the ends of the car, are ¼-in. plate. The end side sheets are $\frac{3}{16}$-in. plate, pressed with an offset to accommodate the side ladders. The side sheets are all pressed inward at the top with ten ¼-in. stiffeners on each side of the car. The sub-side sill is a 9-in. 17.5-lb. channel. The end sills are 9-in. 17.5-lb. channels with 3½-in. by 3½-in. by $\frac{5}{16}$-in. angle connections to the center sills and top cover plate. The corner posts are 3½-in. by 3½-in. by $\frac{5}{16}$ in. angle and the end posts are of 6-in., 8.2 lb. channel, except at the corner where the hand brake is located. The end post at this point consists of two 4-in., 8.2 lb. Z-bars

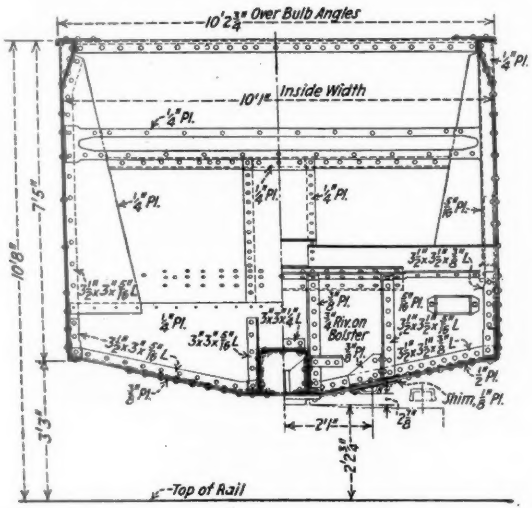


The lower drawing shows a sectional view and side elevation—The plan view gives details of the underframe construction

arranged for the application of the Ajax handbrake. There are six hopper doors pressed from ¼-in. plate known as Ajax corrugated doors manufactured by the Union Metal Products Company. The six doors operate independently and are equipped with the Enterprise Railway Equipment Company's type "D" door operating mechanism.

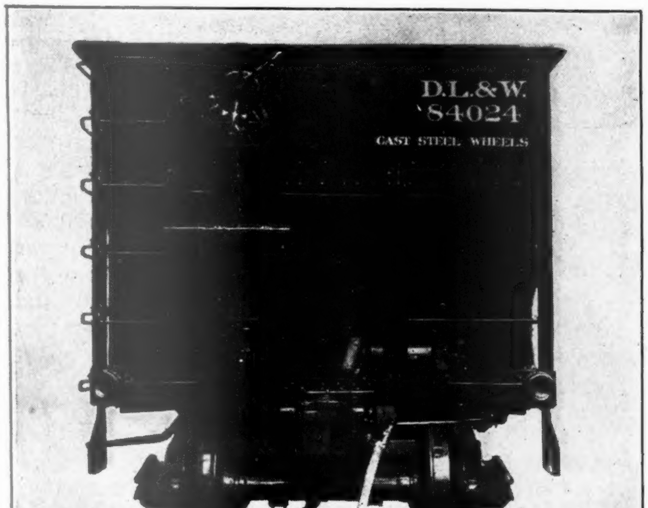
Draft Gear and trucks

The cars are equipped with the Union Draft Gear Company's Cardwell draft gear, type G 111-AA, secured



Typical cross sections of D. L. & W. 70-ton hopper car

between Universal cast steel draft lugs. The couplers, furnished by the Gould Coupler Company, are A. R. A. type "D" with 6-in. by 8-in. shank and the regular A. R. A. but suitable for either the single key, vertical yoke or double key horizontal yoke attachment. The



End view of the car

draft keys used are of 6-in. by 1-in. by ½-in. carbon steel, quenched and tempered, with Universal draft key retainers. The side bearings are of the spring controlled anti-friction type manufactured by E. S. Woods & Company.

The car super-structure is mounted on Bettendorf type four-wheel trucks with a 5-ft. 8-in. wheel base. These trucks have cast steel side frames with journal boxes cast integral and are arranged for six truck springs at each side frame. Cast steel truck bolsters are used, with integral center plates and arranged for the Barber lateral motion device. The springs are A. R. A. double coil, manufactured by the Crucible Steel Company. The journal boxes are fitted with Railway Steel Spring Company's journal box lids and Magnus lead-lined journal bearings, made to the railroad company's specifications. Davis 33-in. diameter steel wheels, manufactured by American Steel Foundries are mounted on 6-in. by 11-in. A. R. A. axles.

The cars are equipped with the National Car Equipment Company's Ajax hand brake which is designed to develop not less than 3,950-lb. pull at the brake cylinder pushrod connection to the cylinder lever. The air brakes are Westinghouse automatic quick action brakes schedule K. D. 1012 with K-2 triple valve, centrifugal dirt collector, double spring retaining valve, 10-20 type and "Wabco" packing rings. The train line piping is 1¼-in. standard wrought iron pipe. A. R. A. No. 2 plus "Creco" trussed brake beams with "Creco" four-point brake beam supports are used.

Principal dimensions of 70-ton cars

Length over pulling face of couplers	43 ft. 11½ in.
Length over buffers	41 ft. 5 in.
Length over end sills	40 ft. 0⅜ in.
Length inside, in the clear	40 ft. 0 in.
Width, over all	10 ft. 2¾ in.
Width, inside	10 ft. 1 in.
Height from top of rail to top of body	10 ft. 8 in.
Height from top of rail to hopper door opening	10⅝ in.
Center to center of side bearings	4 ft. 2 in.
Center to center of trucks	31 ft. 5 in.
Wheel base of trucks	5 ft. 8 in.
Capacity, level full	2,755 cu. ft.
Capacity with 10-in. average heap	3,090 cu. ft.
Light weight	50,800 lb.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Different railroad reports show loss of wheel service metal

On September 19, 1923, the Detroit & Toledo Shore Line applied a pair of wrought-steel wheels to Bessemer & Lake Erie car No. 12680, reporting the service metal to be ½ in. on each wheel. On October 27, 1923, the C. & O. removed these wheels on account of a worn sharp flange. It reported that the service metal was ⅛ in. on each wheel before turning and that after turning, the wheels were scraped. The B. & L. E. objected to the claims of the D. & T. S. L. on the grounds that the wheels applied did not have a full flanged contour, and called the attention of the D. & T. S. L. to the fact that the C. & O. had removed the same pair of wheels for two sharp flanges. As the D. & T. S. L. could not reach an agreement with the C. & O., the B. & L. E. reported the case to the C. & O., but the C. & O could not agree that it was responsible for the loss of service metal. Finally the contending railroads agreed to ask the Arbitration Committee as to who was responsible for the loss of service metal reported.

An investigation by a representative of the Arbitra-

tion Committee developed that the record of the Detroit & Toledo Shore Line did not show whether the wheels applied had standard full flange contour as required by Rule 10. Rule 98 provides that the amount of service metal shall be based on a standard full flange contour. It was also found that the Detroit & Toledo Shore Line used a questionable method of measuring the service metal. The Arbitration Committee decided that "the evidence indicates that the wheels were worn, beyond turning, when applied by the Detroit & Toledo Shore Line. Therefore, the bill should be adjusted accordingly."—*Case No.* 1426—*Detroit & Toledo Shore Line vs. Bessemer & Lake Erie.*

Computing the depreciation for a destroyed freight car

On June 17, 1924, Mobile & Ohio car No. 515 was damaged by fire on the lines of the Chicago, Milwaukee & St. Paul. On request, the owner furnished an appraisal report showing that the car was built new in May, 1923, and at the same time submitted a list of second-hand material used in building the car which included 12 queen posts, the air brake equipment, brake key bolts, king pins and other small metal parts. The Chicago, Milwaukee & St. Paul contended that under A.R.A. rules the car could not be considered as built new in May, 1923, because of the second-hand material used.

Under the conditions as outlined in the case, the Arbitration Committee decided that this was a new car and should be so settled for.—*Case No.* 1383, *Chicago, Milwaukee & St. Paul vs. Mobile & Ohio.*

Responsibility for wrong repairs

The Southern Pacific repaired B. & O. (Mather) car 11260 at its Colton shops, and among other repairs were the following air brake repairs: One F-36 triple valve and cylinder C. O. T. & S., showing no reason for making these repairs and billing repair card making no reference as to stenciling on the car indicating the triple valve standard. The Baltimore & Ohio later repaired this car, it not having been in the possession of the Mather Stock Car Company since having been repaired by the S. P. The B. & O. repair card covered the application of one K-1 triple valve in place of an H-1 triple removed, cylinder and triple cleaned on account of no old date or no old marks, the billing repair card bearing the notation at the bottom "car stenciled K-1." The Mather Stock Car Company presented the B. & O. billing repair card, together with the S. P. billing repair card to the Southern Pacific, under Rule 90, requesting a defect card. The S. P. refused to acknowledge wrong repairs and accordingly the Mather Stock Car Company rendered a bill in amount of $16.69 under Rule 13, payment of which the S. P. declined. The car owner contended that the S. P. made wrong repairs which the B. & O. corrected by applying the K-1 triple valve, its billing repair card indicating that the car was stenciled for a K-1 triple and carried an F-36, and that the S. P. failed to apply a defect card at the time the wrong repairs were made.

The decision of the Arbitration Committee was to the effect that "the Southern Pacific is responsible for the wrong triple valve" in accordance with Rule 90 and Decision No. 1381. That part of the bill representing a "charge for cleaning, etc., ($5.39) should be assumed by the car owner."—*Case No.* 1428, *Mather Stock Car Company vs Southern Pacific.*

Air brakes cleaned twice within a few days not alone an indication that work was improperly performed

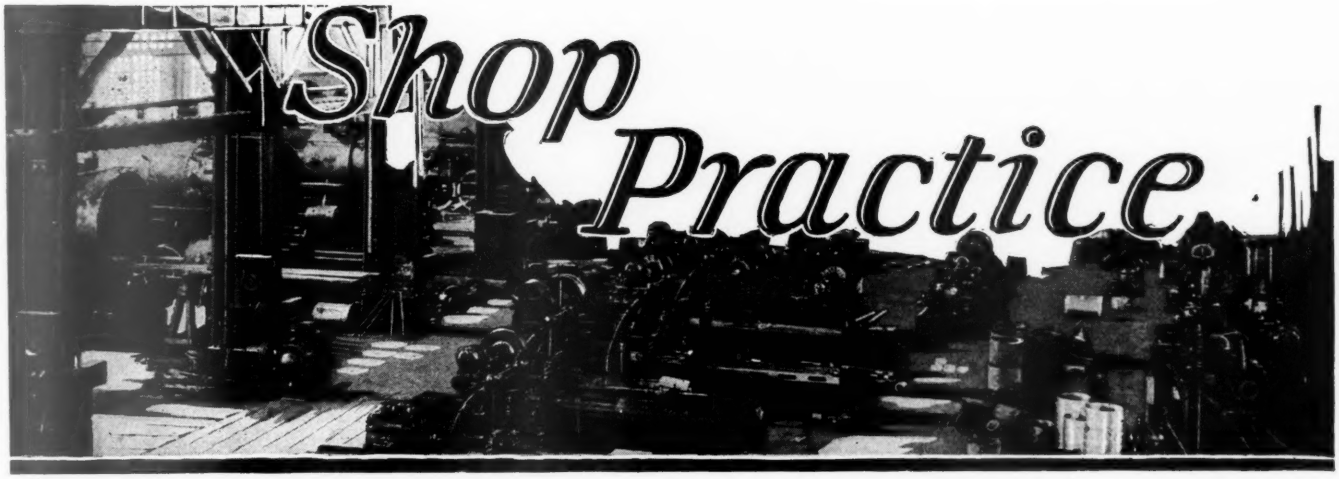
The Richmond, Fredericksburg & Potomac cleaned the air brakes on A. B. & A. car 27157 at Potomac yards. Three days later the Southern cleaned the air brakes on the same car at the Spencer, N. C., shops, because of excessive friction on the slide valve so that the piston would not function until this was remedied, and on account of being dirty. The A. B. & A. submitted the Southern repair card to the R. F. & P. as joint evidence that the air brakes were improperly repaired and cleaned by the R. F. & P., stating that if the triple had received necessary and correct attention it would not have been necessary for the Southern to have repaired and cleaned the air brakes three days later. The R. F. & P. stated that the car in question was received from the Pennsylvania and shopped on account of the air brakes being inoperative when a test was made on inbound inspection. The air brakes of this car were said to have been cleaned and tested on the date in question as required by the A. R. A. rules, and were also tested on the outbound inspection of the car, when they applied and released properly. The R. F. & P. maintained that the condition of friction in the slide valve claimed by the Southern to have existed when the triple valve was tested at Spencer could have easily developed by reason of dust and particles entering the mechanism while being operated in ordinary service. The Southern states that the only work necessary to put the brakes in proper condition was to clean the triple valve.

The Arbitration Committee, in rendering its decision stated that "The evidence is not conclusive that improper or incomplete repairs were made by the R. F. & P. Therefore, the contention of the A. B. & A. is not sustained."—*Case No.* 1429—*Atlanta, Birmingham & Atlantic vs Richmond, Fredericksburg & Potomac.*

Responsibility for tank car found leaking

P O R X tank car No. 715 with a load of gasoline was shipped from the Pittsburgh Oil & Refining Company's plant at Coraopolis, Pa., and delivered to the Pennsylvania at Homestead, Pa. Before delivery of the car at Homestead the tank was found to be leaking. Transfer authority was given the Pennsylvania and the car was immediately transferred and returned empty to the Pittsburgh Oil & Refining Company which made a request on the Pittsburgh & Lake Erie for a defect card to cover the cost of necessary repairs. It was the contention of the car owner that the car was damaged in switching and that the handling line was responsible. The car was inspected at the shipper's plant after loading and later received a running inspection before being placed in a train by the P. & L. E. None of the inspectors held any record of the car leaking at the time of their inspection. Upon delivery to the Pennsylvania, that company's inspector found the tank leaking at the end of the anchorage casting. The handling line contended that the car was not damaged by rough usage but rather that it was damaged due to improper construction in that the anchorage of the tank to the end frame permitted endwise shifting of the tank. The handling line further contended that the leakage was due to the gradual loosening of the anchorage casting rivets.

The Arbitration Committee decided that, "the contention of the Pittsburgh Oil & Refining Company is not sustained. The evidence indicates that this car was not subjected to unfair usage within the scope of Rule 32."—*Case No.* 1430—*Pittsburgh Oil & Refining Company vs Pittsburgh & Lake Erie.*



Applied accuracy in boring driving boxes

By E. F. Stroeh

Shop superintendent, Missouri Pacific, North Little Rock, Ark.

THE elimination of lost motion in railroad back shops has for some years been a disturbing factor with the average shop superintendent and master mechanic. The maximum production obtained at this shop on

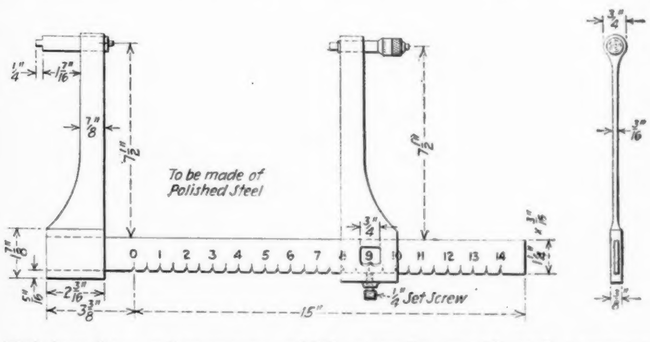
A total of 33 driving boxes every eight hours are machined complete on this boring mill

the boring and facing of driving boxes will, therefore, be of interest to others in the locomotive repair shop.

Since installing a 42-in. driving box boring mill at this point, the production has increased 200 per cent through the fact that the daily production is scheduled in advance to the machine, permitting the planning of output in sequence of operations; that is, facing and dove-tailing of the boxes proper, and the boring, facing and radius forming of the liners.

The average daily output on the finishing operation is 32 boxes every eight hours, or an average elapsed floor to floor time of 12 min. a box. The maximum production is obtained through the ability of the driving box boring mill to take the load and the novel design of a driving box micrometer, shown in the accompanying illustration, designed in this shop, which permits rapid and accurate callipering of the boxes. It further permits the recording of dimensions as a permanent record for future reference.

The micrometer permits callipering the axle with the outside micrometer, which operates with the stationary anvil on one end and a reversible micrometer barrel on the other end. This slides on a verniered rule, thus permitting the micrometer barrel to serve for both inside and outside measurements. For example, in callipering a 9-in. axle for the outside diameter, the micrometer barrel is moved to a positive position on the vernier,



Driving box micrometer which permits rapid and accurate calipering of the boxes

thus reversing the micrometer from an outside "mike" to an inside "mike." This permits accurate callipering of the boxes being machined by setting back the adjustable barrel 3 in. on the rule, thus permitting the taking of a measurement from the periphery of the liner to the cutting edge of the finishing tool in the tool post.

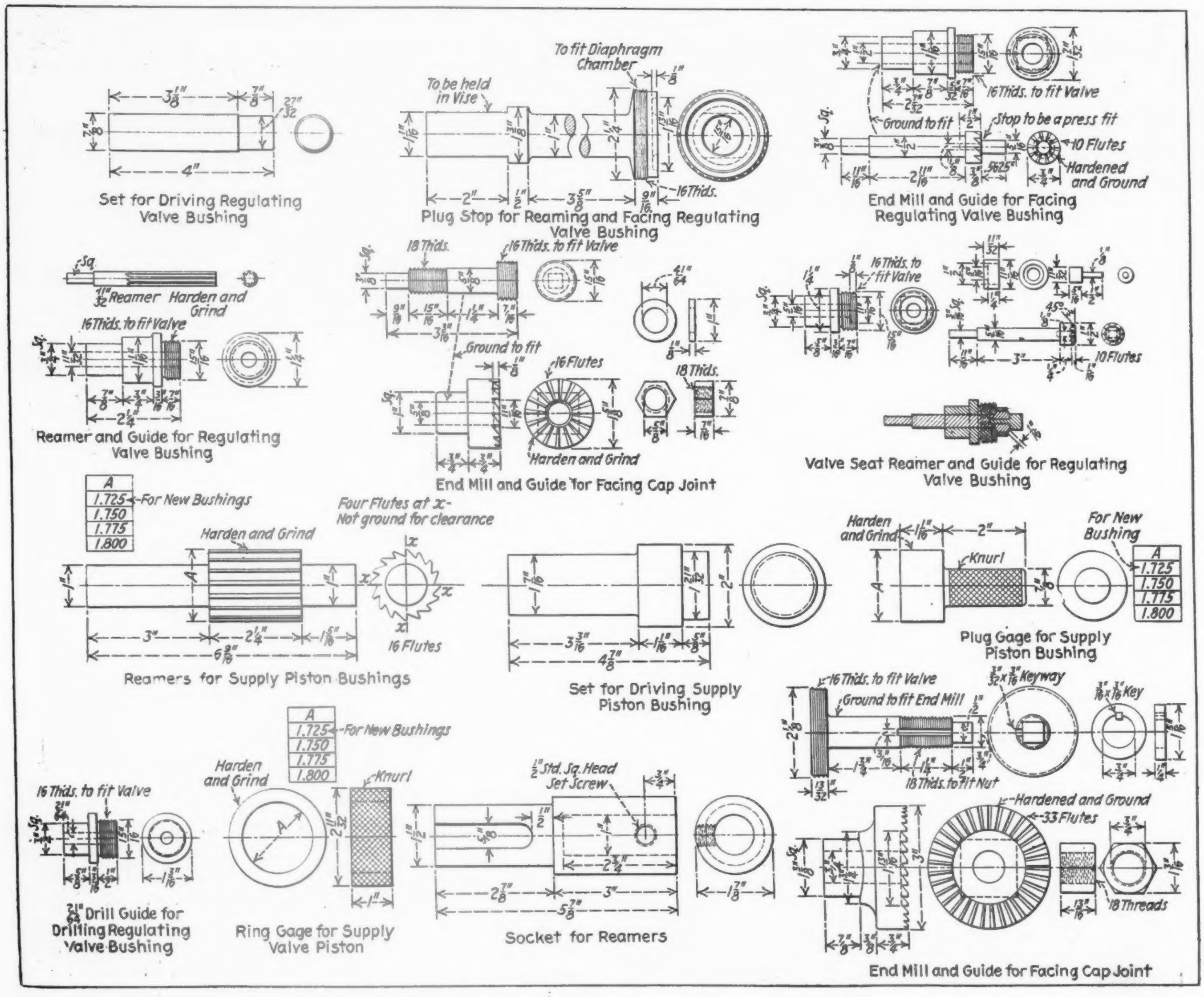
Tools for reclaiming B6 and C6 feed valves

SHOWN in the drawing is a set of fixtures and tools for reclaiming type B6 and C6 feed valves. Referring to the drawing, the tool shown in the upper left hand corner is a set for removing the regulating valve bushing which is used in double pressure feed valves. The next tool at the right is a plug stop for reaming and facing the regulating valve bushing and the last tool at the

right in the top row is an end mill and guide for facing these bushings.

The two tools shown next below at the left are a reamer for finishing the inside of the regulating valve bushing and a guide in which the reamer is held. One end of the guide is threaded so that it can be screwed into the valve in place of the regulating valve cap nut. The end mill and guide shown at the right of the reamer and guide for finishing the inside of the regulating valve bushing is an end mill for facing the cap joint of single pressure feed valves. The cutter fits over the stem of the guide, the large end of which is threaded to screw into the valve in place of the cap nut. The nut and washer is a reamer for finishing the inside of the supply piston bushing. Table *A* gives the dimensions for step diameters for finishing supply piston bushings. The tool shown next to the right in this row is a set used for removing or inserting supply piston bushings. The last tool shown bushing. Table *A* gives the dimensions for step diameter of the supply piston bushing. It is made in four sizes as shown in the table. The tables are shown on the drawing herewith.

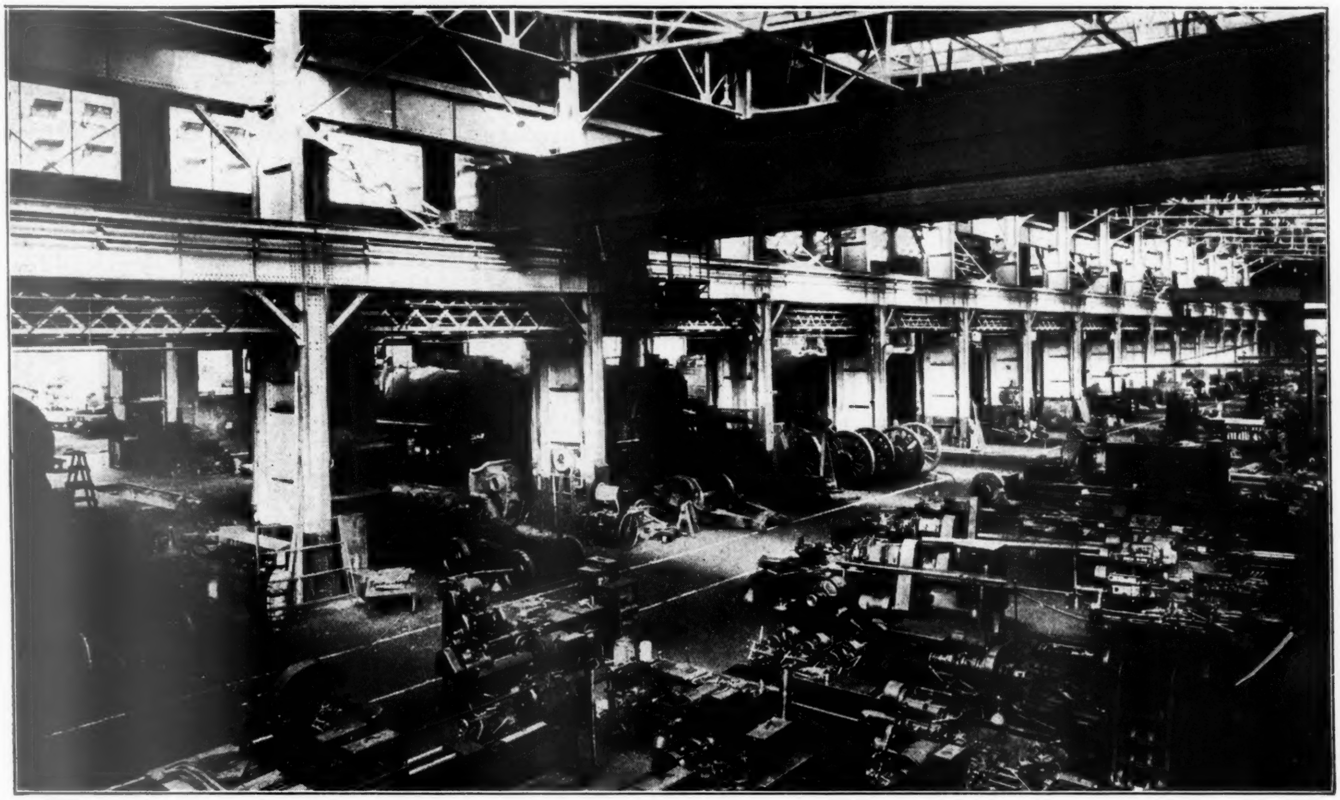
The tool shown in the bottom row at the lower left-hand corner of the drawing is a guide for the 21/64-in. drill used in drilling out the inside hole of the regulating valve bushing. This guide is used in the same manner



Fixtures and tools used for reclaiming B6 and C6 feed valves

shown at the right is screwed onto the stem of the guide over the cutter and the joint is faced by placing a wrench over the square end of the guide and turning the cutter. This tool is used for both single and double pressure feed valves. The last tool in this row is a valve seat reamer and guide for countersinking the regulating valve bushing used in B6 double pressure feed valves. This tool is designed to be used with the guide in the same manner as the reamer and guide for finishing the inside of the bushing.

The tool shown at the left in the third row from the top as the guides for the reamers. The next tool is a ring gage for checking the outside diameter of the supply valve piston. It is also made in four sizes as shown in the table. The third tool shown in the bottom row is a socket for turning the reamers used to finish the inside of the supply piston bushing. The last tool shown in this row, at the lower right-hand corner of the drawing, is an end mill and guide for facing the cap joint of the double pressure feed valve. This tool is used in the same manner as the end mill and guide for facing the cap joint of the single pressure feed valve.



Machine tools ordered in 1926

Lists from 107 roads show a substantial increase of the number of units ordered in 1926 as compared with 1925

THE January, 1925, issue of the *Railway Mechanical Engineer* contained for the first time, a tabulation of machine tools ordered in 1924 by 85 railroads in North America, which represented 87 per cent of the total route mileage on this continent. Through the co-operation of the railroads it was possible to publish similar lists for 1925, and again this year for 1926. However, the number of railroads included in the lists and the number of units ordered have increased each year, with the result that this year's lists contain 107 railroads which represent 87 per cent of the total route mileage of this continent.

The number of units of equipment ordered has likewise increased. For 1924 a total of 1,658 units were reported as ordered by 85 railroads. The number of units ordered by 88 railroads during 1925 totaled 2,594 or an increase of 936 units over the number listed for 1924. This substantial increase can be partly accounted for by the increase in the scope of the types of machine tools listed to include material handling equipment, such as shop trucks, overhead cranes, car and locomotive hoists and small shop hoists, together with such shop equipment as furnaces, motors, air compressors and welding equipment. The same classifications were used for compiling this year's lists. The results show that 107 railroads, representing 87 per cent of the total route mileage, reported as ordering 3,591 units of machine tools and shop equipment during 1926, which is an increase of 997 units over the number listed as ordered for 1925.

Comparison of types ordered

A compilation according to types, of the machine tools and shop equipment ordered during the past year, show that the railroads reported ordering 395 lathes, 296 drill presses, 121 planers, shapers and slotters, 106 boring mills, 63 milling machines, 408 grinding machines, 68 metal cutting saws, 80 portable boring, facing and turning machines, 100 bolt and pipe cutting and threading machines, 98 power presses, 86 hammers and forging machines, 172 boiler shop machines, including punches and shears, and 216 woodworking machines. The shop equipment figures show that the railroads also ordered 100 blowers for forges, ventilating systems, etc., 86 furnaces, 50 overhead cranes, 24 car and locomotive hoists, 211 air, electric and chain hoists, 174 electric and gasoline shop trucks, 135 truck trailers, 28 air brake test racks, 82 air compressors and 158 electric welding sets.

The last 15 years has witnessed an immense increase in the size of locomotives in the construction of which large steel castings, some of alloy steel, and heavy alloy steel forgings, are used. It has been found that many of the older types of standard equipment in railway shops do not have sufficient capacity and auxiliary equipment to machine adequately and economically the parts of the

modern locomotive. This fact may be partly responsible for the steady increase in some types of tools and shop equipment.

During the past few years considerable has been written and said about the place grinding and milling machines would take in the railroad shops. The gist of this discussion has been that these two types of machines would, in future years, rank in importance next to the lathe and drill press. During 1924, the railroads ordered 240 grinders, during 1925, 291 grinders and during 1926, 408 grinders. They also ordered 40, 38 and 63 milling machines during 1924, 1925 and 1926, respectively. These figures indicate a well defined trend toward a wider shop application of these types of machine tools.

To facilitate the servicing of locomotives at terminals, as well as for use in the back shop, the railroads are buying portable tools, such as boring, facing and turning machines and welding equipment. Last year 80 portable boring, facing and turning machines and 158 electric welders were ordered as compared with 58 and 110, respectively, during 1925. These figures show a substantial increase.

In spite of the tendency to replace wood cars with steel cars, the orders for woodworking machinery have increased from 146 units in 1924 to 160 units in 1925, and to 216 units in 1926. As already pointed out, wooden passenger cars are fast disappearing, but it will be many years before freight cars are all built of steel, if indeed they ever are. So the demand for woodworking machinery continues.

Material handling equipment

The railroads are not only purchasing modern machine tools to reduce maintenance costs, but are also buying material handling devices and other shop equipment, the purpose of which is to facilitate shop methods. The large number of units of this equipment listed this year indicates the type of labor-saving facilities with which the railroads are supplementing their new machine tools. Cars and locomotives can be handled by either overhead cranes or hoists. The lists include 50 of the former and 24 of the latter. The purchases also include 211 air, electric and chain hoists, used for lifting car and locomotive parts. The production of modern machines as well as the repair output of the shop as a whole depends somewhat on the adequacy of intra-shop transportation facilities for the movement of material. In the past, this transportation has been provided by hand trucks which the railroads have been somewhat slow in replacing with power trucks. That some improvement is being effected, however, is indicated by the fact that 98 electric trucks and 86 gasoline trucks were purchased last year, together with 135 trailers for use with the gasoline and electric trucks.

Furnaces and blowers are used extensively in the boiler shop, flue shop, blacksmith shop and in the car department. Among the smaller types of furnaces are listed 18 electric, 65 oil, as well as a number of equipments for such purposes as tempering and brass melting, some of which are gas fired.

The railroads ordered 28 air brake test racks last year. Eighty-two air compressors of various types were also ordered for shop use.

The lists included with this article give in as complete detail as possible the number, size or other capacity designation, and type or kind of equipment ordered by each railroad during 1926 for which the data are available. The name of the builder or company from which the equipment was purchased is included where ever possible.

The machine tools and shop equipment ordered by the railways in 1926

Akron, Canton & Youngstown

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 51	Oliver drill pointer	Strong, Carlisle & Hammond Co.
1	9 in. by 9 in.	High speed shaping saw	Strong, Carlisle & Hammond Co.
1	1 ton	Wright steel hoist	Cleveland Tool & Supply Co.
1	1 ton	Fordson tractor with crane	Tractor Sales Co.
1	700-cu. ft.	Air compressor	Bury Compressor Co.

Alabama Great Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	12-in. by 5 ft.	American portable lathe	Aumen Machinery Co.
1	16-in. by 7-ft.	Lehmann portable engine lathe	Carey Machinery & Supply Co.
2	18-in. by 10-ft.	Engine lathes	Cisco Machine Tool Co.
1	24-in. by 11-ft. bed	Lehmann engine lathe	Carey Machinery & Supply Co.
1	20-in.	Dreses universal monitor lathe	Manning, Maxwell & Moore.
1	90-in.	Driving wheel lathe	Niles-Bement-Pond Co.
1	4-in. by 34-in.	Hartness flat turret lathe	Jones & Lamson Machine Co.
1	6-ft.	Ridgway radial drill	Niles-Bement-Pond Co.
1	20-in.	Cincinnati vertical drill press	Hamilton Machinery Company.
1	28-in.	Cincinnati vertical drill press	Hamilton Machinery Company.
1	42-in. by 42-in.	Betts heavy duty planer	Consolidated Machine Tool Corp.
1	32-in.	Cincinnati shaper	Swind Machinery Co.
1	30-in.	Gisholt vertical boring mill	Swind Machinery Co.
1	54-in.	Colburn vertical boring mill	Consolidated Machine Tool Corp.
1	No. 3	Cincinnati universal milling machine	Hamilton Machinery Co.
1	32-in. gap, 96-in. betw. centers	Cincinnati cylindrical grinder	Hamilton Machinery Co.
1	No. 76	Floor grinder	Safety Emery Wheel Co.
2	Type 7-LA	Hisey double end floor grinders	Hamilton Machinery Co.
2	2½-in., double head	Bolt threading machines	Landis Machine Co.
1	1-in. to 4-in.	Merrill pipe cutter and threader	D. Nast Machinery Co.
1	No. 1	Underwood pipe bending machine	Stoer Machinery Co.
1	2,000-lb.	Steam hammer	Niles-Bement-Pond Co.
1		Horizontal hoist	Ingersoll-Rand Co.
2		Gasoline tractors	International Harvester Co.
1		Gasoline tractor	Litsinger Motor Co.
1		Electric crane truck	Edwell-Parker Electric Co.
16		Lumber trucks	Chicago Crane & Hoist Co.
1	2,500-cu. ft.	Air compressor	Ingersoll-Rand Co.
2		Air compressors	Chicago Pneumatic Tool Co.
2	3 hp.	Induction motors	Fairbanks-Morse & Co.
1	3 hp.	Induction motor	Graybar Electric Co.
3	10 k.v.a.	Transformers	Wagner Electric Corp.
6	25 k.v.a.	Transformers	Wagner Electric Corp.
4		Arc welding motor generator sets	Westinghouse Electric & Mfg. Co.
1		Motor generator set	Electric Products Co.

Atlantic City

No.	Size and capacity	Type of machine	Builder or dealer
1	4-in.	Vertical drill press	Baker Bros.

Atlantic Coast Line

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Putnam journal turning and quartering machine	Manning, Maxwell & Moore
3		Betts journal truing and axle lathes	Railway Specialty Corp.
1	16-in. by 5-ft.	Pratt & Whitney engine lathe	Niles-Bement-Pond Co.
2	14-in. by 6-ft.	Motor driven lathes	Rahn Larmon Co.
5	14-in. by 6-ft.	Monarch portable lathes	Manning, Maxwell & Moore
5	18-in. by 10-ft.	Boye & Emmes engine lathes	Manning, Maxwell & Moore
5	20-in. by 10-ft.	Boye & Emmes engine lathes	Manning, Maxwell & Moore
2	24-in. by 10-ft.	Boye & Emmes engine lathes	Manning, Maxwell & Moore
2	24-in. by 12-ft.	Boye & Emmes engine lathes	Manning, Maxwell & Moore
1	30-in. by 14-ft.	Engine lathe	Joseph T. Ryerson & Son

No.	Size and capacity	Type of machine	Builder or dealer
1	E-48 in.	Hilles & Jones vertical punch and shear	Consolidated Machine Tool Corp.
1	8-ft.	Chicago steel cornice brake	Dreis & Krump Mfg. Co.
1		Blower and exhauster	Buffalo Forge Co.
1	2-ft. 10-in. by 5-ft. 4-in.	Ferguson oil hammer furnace	Railway Materials Corp.
1	No. 108	Combination melting furnace and heater	Hauck Manufacturing Co.
1	No. 6-F	Brazing forge	Hauck Manufacturing Co.
4	No. 98-R	Down draft forges	Buffalo Forge Co.
1	25-ton; 5-ton aux.	Electric traveling crane	Niles-Bement-Pond Co.
1	200-amp.	Portable electric welder	U. S. Light & Heat Corp.

Ann Arbor

No.	Size and capacity	Type of machine	Builder or dealer
1	¾-in. to 2-in.	Double-head bolt threader	National Machinery Co.
1	1,200-lb.	Lunkenheimer metal and melting furnace	Strong Carlisle & Hammond Co.

Atchison, Topeka & Santa Fe

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal truing lathe	Manning, Maxwell & Moore.
1	100-in.	Double end wheel quartering machine	Niles-Bement-Pond Co.
1	No. 4	Niles car wheel lathe	Niles-Bement-Pond Co.
2	14-in. by 6-ft.	Engine lathes	Manning, Maxwell & Moore.
1	20-in. by 10-ft.	Engine lathe	Hendy Machine Co.
1	30-in. by 12-ft.	Engine lathe	Herberts Machinery & Supply Co.
1		Truck and trailer tire truing lathe	Niles-Bement-Pond Co.
1	3-ft.	Radial drill press	E. L. Essley Machinery Corp.
1	26-in.	Sensitive drill press	E. L. Essley Machinery Corp.
1		Staybolt drill press	Stocker Rumely, Wachs Co.
1	No. 263	Drilling and tapping machine	Barnes Drill Co.
1	4-spindle	Mud ring drill	Niles-Bement-Pond Co.
1	32-in.	Invincible shaper	Gould & Eberhardt.
1	32-in.	Single head shaper	Marshall & Huschart Mchy. Corp.
1	42-in.	Vertical boring machine	E. L. Essley Machinery Corp.
1	54-in. by 30-in. by 16-ft.	Horizontal milling machine	Ingersoll Milling Machine Co.
1		Die making machine	Oliver Instrument Co.
1		Pedestal milling machine	Stocker, Rumely, Wachs Co.
2	8,875-lb.	Internal grinders	Micro Machine Co.
1		Radius link grinder	Manning, Maxwell & Moore.
1	20-in.	Disc grinder	C. H. Besly & Co.
1		Universal tool grinder	Neff, Kohlbusch & Bissel Co.
5		Double end dry grinders	Marshall & Huschart Mchy. Corp.
1		Double end dry emery grinder	Harron, Richard & McCone Co.
1	18-in.	Wet grinder	Manning, Maxwell & Moore.
1		Single end wet tool grinder	Manning, Maxwell & Moore.
1		Cutter grinder	Manning, Maxwell & Moore.
1		Automatic metal cutting off machine	Stocker, Rumely, Wachs Co.
1	1½-in.	Landis staybolt cutter	Marshall & Huschart Mchy. Corp.
1	2-in., double head	Landis bolt threading machine	Marshall & Huschart Mchy. Corp.
1		Automatic stud machine	Cleveland Automatic Machine Co.
2	4-in.	Oster pipe and nipple threaders	Crerar, Adams & Co.
1	300-ton	Chambersburg hydraulic bushing press	Lee & Clark, Inc.
1	100-lb.	Bradley hammer	Herberts Machinery & Supply Co.
1	4,000-lb.	Steam hammer	Niles-Bement-Pond Co.
1	72-in.	Squaring shear	W. A. L. Thompson Hardware Co.
1		Ring and circular shear	Hibbard-Spencer-Bartlett & Co.
1		Combination punch and shear	Neff, Kohlbusch & Bissel Co.
1		Pneumatic coupler yoke riveter	Lee & Clarke, Inc.
1		Annealing furnace	Mahr Manufacturing Co.
1		Babbitt furnace, oil fired	Mahr Manufacturing Co.
1	No. 12-D	Fuel oil rivet forge	Mahr Manufacturing Co.
1	400-gal.	Steam oil heater	Mahr Manufacturing Co.
2		Electric furnaces	Hopkins Manufacturing Co.
1		Rip saw	Yates American Machine Co.
1	36-in.	Automatic swing cut-off saw	Greenlee Bros. & Co.
1	5-ton	Electric traveling crane	Harnishfeger Corp.
8	100-ton	Pit hoists	Whiting Corp.
1	125-ton	Electric traveling crane	Harnishfeger Corp.
1	2-ton	Stiff leg derrick and winch	Crerar, Adams & Co.
3	1-ton	Geared air hoists	Independent Pneumatic Tool Co.
1	1½-ton	Geared air hoist	Independent Pneumatic Tool Co.
1	2-ton	Air hoist	Chicago Pneumatic Tool Co.
1	3-ton	Geared air hoist	Independent Pneumatic Tool Co.
2	½-ton	Chain hoists	Crerar, Adams & Co.
3	1-ton	Post cranes	J. D. Higgins & Co.
1	1½-ton	Post cranes	J. D. Higgins & Co.
1	2-ton	Post cranes	J. D. Higgins & Co.
1	3-ton	Post crane	J. D. Higgins & Co.
2	36-in. by 14-ft.	Boye & Emmes engine lathes	Manning, Maxwell & Moore
1	24-in. by 16-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
2		Dresses monitor lathes	Manning, Maxwell & Moore
1		Libby turret lathe	Manning, Maxwell & Moore
1	2¼-in. by 24-in.	Hartness flat turret lathe	Jones & Lamson Machine Co.
3	3-in. by 36-in.	Hartness flat turret lathes	Jones & Lamson Machine Co.
1	90-in.	Wheel lathe	William Sellers & Co.
2	42-in.	Car wheel lathes with cranes	William Sellers & Co.
3	6-ft.	Carlton radial drills	Walraven Co.
2	6-ft.	American triple purpose radial drills	Smith-Courtney Co.
3	32-in.	Sliding head drill presses	Joseph T. Ryerson & Son
5	36-in.	Vertical drilling machines	Manning, Maxwell & Moore
8	Single spindle	Allen sensitive drill presses	Manning, Maxwell & Moore
1	36-in. by 36-in. by 14-in.	Planer	William Sellers & Co.
1	60-in. by 54-in. by 20-ft.	Planer	William Sellers & Co.
1	24-in.	American crank shaper	Smith-Courtney Co.
3	28-in.	American crank shapers	Smith-Courtney Co.
2	30-in.	Draw cut shapers	Morton Manufacturing Co.
2	36-in.	Draw cut shapers	Morton Manufacturing Co.
1	No. 32	Giddings & Lewis horizontal boring machine	Smith-Courtney Co.
1	24-in.	Vertical lathe	Bullard Machine Tool Co.
1	36-in.	Vertical lathe	Bullard Machine Tool Co.
2	42-in.	Car wheel lathes	William Sellers & Co.
2	42-in.	Vertical torret lathes	Bullard Machine Tool Co.
1	44-in.	Maxi-mill	Bullard Machine Tool Co.
2	52-in.	Betts car wheel boring machines	Railway Specialty Corp.
1	54-in.	Maxi-mill	Bullard Machine Tool Co.
2	100-in.	Boring and turning mills	Niles-Bement-Pond Co.
1	48-in. by 48-in. by 14-ft.	Slot milling machine	Niles-Bement-Pond Co.
1	3B	Kearney & Trecker milling machine	Smith-Courtney Co.
1	4-in.	Whiton centering machine	Smith-Courtney Co.
1	No. 6	Jackson die sinker	Manning, Maxwell & Moore
1		Surface and internal link grinder	Manning, Maxwell & Moore
9	18-in. by 3-in.	Grinding machines	Hisey-Wolf Machine Co.
1	14-in. by 2-in.	Diamond swing frame grinder	Niles-Bement-Pond Co.
2	24-in. by 3½-in.	Grinding machines	Hisey-Wolf Machine Co.
1	20-in. by 4-in.	Floor grinding machine	Hisey-Wolf Machine Co.
1		Wilmarth & Morman drill grinder	Smith-Courtney Co.
1	No. 3	Universal grinder	Landis Tool Co.
1		Landis chaser grinder	Wright & Co.
1		Rotary and lap plate truing device	Special Bolt Machinery Corp.
1	6-spindle	Turner cock grinder	Manning, Maxwell & Moore
1		Rotary valve seat facer	Commonwealth Supply Co.
3		Peerless power hack saws	Manning, Maxwell & Moore
4		Universal portable boring bars	H. B. Underwood Corp.
2		Portable crank pin turning machines	Walraven Co.
1	1½-in.	Landis bolt threader	Woodward, Wright & Co.
1		Acme bolt cutter	Smith-Courtney Co.
1	4-in.	Peerless pipe threader and cutter	Bignall & Keeler Machine Works
1		Pipe threading machine	Walraven Co.
1	80-ton	Chambersburg trimming press	Manning, Maxwell & Moore
2	100-ton	Chambersburg bushing presses	Manning, Maxwell & Moore
1	800-ton	Chambersburg wheel press	Manning, Maxwell & Moore
1	600-ton	Chambersburg car wheel press	Manning, Maxwell & Moore
1	1,500-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
2	2,000-lb.	Chambersburg steam hammers	Manning, Maxwell & Moore
2	300-lb.	Bradley helve hammers	Smith-Courtney Co.
1		Chambersburg blacksmith hammer	Manning, Maxwell & Moore
1	No. 4	Horizontal punch	Southwark Foundry & Machine Co.
1	G-372	Peck, Stow & Wilcox gap shear	Smith-Courtney Co.
1	No. 652	Niagara power gap shears	Smith-Courtney Co.
1	40-A	Rotary shear	Walraven Co.
2	60-in.	Single end shears	Chambersburg Engineer Co.
1	4-in., round	Alligator shear	Doelger & Kirsten
1		Punch and shear	Henry Pels & Co.
2	Type B-15	Electric flue welders	Winfield Elec. Welding Mach. Co
2		Flue welding machines	Joseph T. Ryerson & Son
1	No. 3	Hilles & Jones plate bending roll	Railway Specialty Corp.
1		Flanging machine	McCabe Manufacturing Co.
1		Allen mud ring riveter	Manning, Maxwell & Moore.
18		Low pressure blowers	Buffalo Forge Co.
4	300-cu. ft.	Blowers	Buffalo Forge Co.
13	500-cu. ft.	Blowers	Buffalo Forge Co.
1	800-cu. ft.	Blower	Buffalo Forge Co.
1		Tool tempering furnace	Railway Material Corp.
1		Dries & Krump steel power brake	Manning, Maxwell & Moore
1	No. 818	Dries & Krump bending brake	Smith-Courtney Co.
1	20-in.	Hand planer and jointer	Oliver Machine Tool Co.
1	No. 34-B	Vertical spindle and disc sander	Oliver Machine Tool Co.

Atlantic Coast Line

No.	Size and capacity	Type of machine	Builder or dealer
1	1,000-lb.	Electric hoist	Shepard Electric Crane & Hoist Co.
2	6,000-lb.	Jib cranes	Armington Engineering Co.
1	11-in. by 12-in., single cylinder	Air compressor	Worthington Pump & Mchy. Corp.
2	15-in. by 9¼-in. by 12-in.	Air compressors	Ingersoll-Rand Co.
2	23-in. by 14-in. by 16-in.	Air compressors	Ingersoll-Rand Co.
7		Portable electric welding outfits	Morton Manufacturing Co.

Baltimore & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal turning lathe	Manning, Maxwell & Moore
1	28-in. by 10-ft.	Axle lathe	Louis E. Emerman & Co.
1	11-in. by 4-ft.	Engine lathe	South Bend Lathe Works
1	16-in. by 8-ft.	Tool room lathe	Aumen Machinery Co.
1	50-in.	Engine lathe	Louis E. Emerman & Co.
1	No. 3	Wheel lathe	Niles-Bement-Pond Co.
1	4-ft.	Cincinnati radial drill	Kemp Machinery Co.
1	4-ft.	Radial drill	Manning, Maxwell & Moore
1	5-ft.	Radial drill	Louis E. Emerman & Co.
1	36-in.	Drilling machine	Stoer Machinery Co.
1	No. 5	Rail drill	Louis E. Emerman & Co.
1	42-in. by 24-in. by 18-ft.	Gray frog and switch planer	Swind Machinery Co.
2	24-in.	Climax shapers	Swind Machinery Co.
1	20-in.	Dill slotter	Carey Machine & Supply Co.
1	24-in.	Dill slotter	Nazel Engineering & Mach. Works
1	53-in.	Boring mill	Louis E. Emerman & Co.
3	54-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	54-in.	Boring and facing machine	William Sellers & Co.
1	5-in.	Baker rod boring machine	Swind Machinery Co.
1	No. 3	Niles car wheel lathe	Niles-Bement-Pond Co.
1	No. 1	Horizontal milling mach.	Beckett-Miller Co.
1	No. 4-A	Universal milling machine	Carey Machine & Supply Co.
1	Knee type	Milling machine	Kemp Machinery Co.
1	42-in. by 30-in. by 16-ft.	Horizontal spindle milling machine	Ingersoll Milling Machine Co.
1	54-in.	Adjustable rotary milling machine	Ingersoll Milling Machine Co.
1	58-in.	Niles rod milling machine	Niles-Bement-Pond Co.
1	12-in. by 36-in.	Universal grinding machine	Norton Co.
1	30-in. by 84-in.	Diamond face grinder	Fitzsimmons & Cole
2	16-in. by 40-in. by 120-in.	Piston rod grinders	Norton Co.
7		Ransom dry grinding machines	Motch & Merryweather Mach. Co.
1	3-spindle	Frame drilling machine	William Sellers & Co.
1	No. 1	Angle cock grinder	Manning, Maxwell & Moore
1		Chaser grinder	Landis Machine Co.
1		Drill grinder	Wilmarth & Morman Co.
1	6-in. by 6-in.	Power hack saw	Manning, Maxwell & Moore
1	No. 402	Metal cutting band saw	Wm. Laidlaw, Inc.
1	No. 2	Underwood portable crank pin turning machine	Manning, Maxwell & Moore
6	3½-in.	Underwood boring bars	Manning, Maxwell & Moore
5	3-in.	Underwood boring bars	Manning, Maxwell & Moore
1	No. 3	Underwood locomotive cylinder facing mach.	Manning, Maxwell & Moore
1		Valve chamber boring bar	Manning, Maxwell & Moore
2	2-in.	Triple head bolt cutters	Landis Machine Co.
1	1½-in.	Bolt threading machine	Landis Machine Co.
2	4-in.	Oster pipe threader and cutters	Manning, Maxwell & Moore
1		Lever tapping machine	Sloan & Chase
1	8,000-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
1		Chambersburg mechanical sledge	Manning, Maxwell & Moore
1		Forging machine	Ajax Manufacturing Co.
1	No. 8	Tie plate punch	Consolidated Machine Tool Corp.
1		Open throat shear	Consolidated Machine Tool Corp.
1		Hilles & Jones bar shear	Louis E. Emerman & Co.
1	No. 5	Punch and shear	L. A. Benson Co.
1	6-in.	Flue welder	Thomson Electric Welding Co.
13	No. 105	Mechanical painting machines	W. N. Matthews Corp.
1	No. 154	Mechanical painting machine	W. N. Matthews Corp.
1	50-ton	Electric drop table	Whiting Corp.
1	1-ton	Pneumatic hoist	Detroit Hoist & Derrick Co.
2	2-ton	Yale & Towne electric hoists	J. R. Maginnis
2	2-ton	Electric hoists	Carey Machine & Supply Co.
7	440-volt	Electric hoists	Shepard Electric Crane & Hoist Co.
5	550-volt	Electric hoists	Shepard Electric Crane & Hoist Co.
1	Type 3-V-5-30	Air compressor	Westinghouse Traction Brake Co.
1	5½ in. by 4½ in.	Air compressor	Worthington Pump & Mchy. Corp.
1		Air compressor	Economy Furnace Co.
1	50-ton	Electric travel crane	Manning, Maxwell & Moore

Canadian Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	56-in.	Journal turning lathe	Canadian Machinery Corp.
1		Axle lathe	J. Bertram & Sons Co.
1	18-in.	Brass-finisher turret lathe	Warner & Swasey Co.
1	No. 2	Universal turret lathe	Acme Machine Tool Co.
1	5-ft.	Radial drill	Canadian Machinery Corp.
1	5-ft.	Radial drill	J. Bertram & Sons Co.
2	20-in.	Vertical drill presses	Aurora Tool Works
1	36-in.	Vertical drill press	J. Bertram & Sons Co.
1	6-spindle	Semi-automatic nut tapping machine	Acme Machine Co.
1	42-in. by 42-in. by 12-ft.	Planer	J. Bertram & Sons Co.
1	32-in.	Shaper	J. Bertram & Sons Co.
2	No. 8	Vertical milling machines	A. Herbert & Son
1		Vertical milling machine	Kendall & Gent (England).
1	8,875-lb.	Internal grinder	Micro Machine Co.
1	24-in.	Surface grinder	Diamond Machine Co.
1	No. 12	Cutter grinder	Landis Tool Co.
1	6-in.	Hack saw	Racine Tool & Machine Co.
1	30-in.	Hot saw and burring machine	Ajax Manufacturing Co.
2	2-in.	Pipe threading machines	Hall-Wills Co.
1	30-ton	Hydraulic bushing press	Hydraulic Machinery Co.
1	1,200-lb.	Steam hammer	J. Bertram & Sons Co.
1	8-in.	Wood planer and matcher	Preston Wood Working Mach. Co.
1	36-in.	Wood surface planer	Canadian Machinery Corp.
1	3,000-lb.	Jib-crane on electric truck	Elwell-Parker Electric Co.

Central New England

No.	Size and capacity	Type of machine	Builder or dealer
1	100-ton	Hydro-pneumatic press	Watson-Stillman Co.

Chicago, Burlington & Quincy

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 8-ft.	Engine lathe	
1	20-in. by 10-ft.	Engine lathe	
1	36-in. by 16-ft.	Engine lathe	
1	36-in.	Vertical drill	
1	36-in.	Crank shaper	
1	36-in. by 36-in. by 12-ft.	Planer	
1		Portable car wheel grinder	
1	14-in. by 2-in.	Pedestal grinder	
5	18-in., 5-hp.	Pedestal grinders	
1	12-in. by 2-in.	Pedestal grinder	
2	10-in. by 1-in.	Bench grinders	
2	12-in., 2-hp.	Bench grinders	
1	24-in. by 3-in.	Wet tool grinder	
1	30-in.	Automatic knife grinder	
1	6-in. by 6-in.	Power hack saw	
1	9-in. by 9-in.	Power hack saw	
1	10-in. by 10-in.	Metal band saw	
2	No. 2	Crank pin turning machines	
1	3½-in. by 6-ft.	Piston valve boring bar	
1	5-in. by 7-ft.	Cylinder boring bar	
1	500-lb.	Power blacksmith sledge	
1	No. 29-U	Bulldozer	
1	42-in., 2-in.	Punch	
1	½-in.	Serpentine shear	
1		Double angle shear	
1	6-ft., 24-in. throat	Gate shear	
1	36-in. throat, 1-in.	Single end punch and shear	
1	No. 2	Pressure blower	
3	300-C.F.	Pressure blowers	
1	400-C.F.	Pressure blower	
5	525-C.F.	Pressure blowers	
4	600-C.F.	Pressures blowers	
1	700-C.F.	Pressure blower	
1	825-C.F.	Pressure blower	
1	1,750-C.F.M.	Pressure blower	
1	54-in. by 15-in.	Forging furnace	
1		Rivet forge	
1	30-in. by 14-in.	Matcher	
1	24-in. by 14-in.	Timber sizer	
1	16-in.	Cut-off saw	
1		Cut-off saw	
1	20-in.	Band saw	
1	24-in.	Universal sander	
1	No. 74	Painting machine	
1	10-gal.	Painting machine	
1	7½-ton	Electric traveling crane	
1	3-ton	Pneumatic hoist	

Bangor & Aroostook

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 2	Alligator shear	Doelger & Kirsten
1	1-ton	Electric hoist	Manning, Maxwell & Moore

Bessemer & Lake Erie

1	1-ton	Electric hoist	Euclid Crane & Hoist Co.

Boston & Albany

1	45-in.	Journal truing lathe	
2	13-in. by 6-ft.	Engine lathes	
1	18-in. by 6-ft.	Engine lathe	
1	16-in. by 8-ft.	Engine lathe	
1	20-in. by 8-ft.	Engine lathe	
1	20-in. by 11-ft.	Engine lathe	
2	24-in. by 12-ft.	Engine lathes	
1	30-in. by 12-ft.	Engine lathe	
1	4-ft.	Radial drill	
1	3½-in., 2-spindle	Bolt centering machine	
1	Single spindle	Vertical drill press	
1	4-spindle	Staybolt drilling machine	
1	36-in. by 36-in. by 10-ft.	Double head planer	
1	20-in.	Slotter	
1	26-in. by 42-in.	Horizontal boring machine	
1	30-in. by 63-in.	Horizontal boring machine	
1	42-in.	Vertical turret lathe	
2	52-in.	Car wheel boring mills	
1	30-in. by 10-ft.	Horizontal milling machine	
1	28-in. by 10-in. by 18-ft.	Milling machine	
1	30-in. by 84-in.	Face grinding machine	
1	18-in. by 18-in. by 5-ft.	Automatic surface grinder	
1	6-in.	Metal cutting band saw	
1	4½-in. by 6-ft. 6-in.	Portable cylinder boring bar	
1	4-in. by 7-ft.	Portable valve boring bar	
1	4-spindle	Staybolt turner and threader	
1	1-in. to 3½-in.	Nut facing machine	
1	700-lb.	Air hammer	
1	1,250-lb.	Steam hammer	
1	2,000-lb.	Steam hammer	
1	100-ton	Hydraulic spring stripping machine	
1	Type D	Stock adjusting machine	
1	36-in.	Automatic cut-off saw	
1	24-in.	Edging and ripping saw	
3	1,000-lb.	Air hoists	
3	2,000-lb.	Air hoists	
1	4,000-lb.	Air hoist	

Boston & Maine

1		Axle lathe	Consolidated Machine Tool Corp.
1	Double end	Car axle lathe	Manning, Maxwell & Moore
1	⅛-in. to ⅞-in	Tool makers lathe	Niles-Bement-Pond Co.
1	½-in. by 7-in	Two-spindle centering machine	Taylor Machinery Co.
1	36-in.	Shaper	Joseph T. Ryerson & Son
1	36-in.	Ohio shaper	Joseph T. Ryerson & Son
1	36-in.	Columbia shaper	Manning, Maxwell & Moore
1	42-in.	Vertical turret boring mill	Bullard Machine Tool Co.
1	10-in.	Henrickson journal bearing boring machine	Ar-An-Ess Manufacturing Co.
1	8-in. to 36-in	Circular saw grinder	Manning, Maxwell & Moore
1	3-hp.	Tool post grinder	Taylor Machine Co.
1	7½-hp.	Sundstrand surface grinder	Manning, Maxwell & Moore
1	4-spindle	Straight and taper bolt turning machine	Special Bolt Machinery Co.
1	2-in.	Geist pipe cutter	Landis Machine Co.
1	¼-in. to 2-in	Double head pipe threader	Landis Machine Co.
1	1,500-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
1	3,300-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
1	1-hp.	Blacksmith hammer	Blacker Engineering Co.
1	[illegible]-in.	Angle iron punch	Joseph T. Ryerson & Son
1	24-in.	Combined punch and shear	Cleveland Punch & Shear Works
1	No. 454	Single spindle sand-papering machine	J. A. Fay & Egan Co.
1	24-in.	Motor driven single surfacer	Yates American Machine Co.
3	1½-ton	Electric crane trucks	Elwell-Parker Electric Co.
1	70-in.	Electric crane truck	Baker Rauling Co.
3	200 amp.	Portable electric welders	General Electric Co.
2	200-amp.	Gen. Elec. portable electric welders	Pettingill-Andrews Co.

No.	Size and capacity	Type of machine	Builder or dealer
2	1-ton	Electric hoists	
1	2-ton	Electric hoist	
1	3-ton	Electric hoist	
6		Gasoline crane tractors	
7		Gasoline tractors	
3		Electric crane tractors	
7		Narrow gage tractors	
1	10-D	Spot welder	

Chicago Great Western

1	32-in.	Newton crank planer	Consolidated Machine Tool Corp.
1	4-ft.	Dresses radial drill	Manning, Maxwell & Moore.
1	5-ft.	Dresses radial drill	Manning, Maxwell & Moore.
1	No. 2	Portable crank pin turning machine	H. B. Underwood Corp.
4	No. 14	Rivet heaters	Mahr Manufacturing Co.

Chicago, Indianapolis & Louisville

1		Semi-automatic valve finishing machine	Special Bolt Machinery Corp.
1	2-in.	Pipe machine	Oster Manufacturing Co.
1	3½-in. round, 2-in. by 8-in. flat	Open gap shear	Cleveland Punch and Shear Works.
1	10-ft. by 10-ft.	Plate annealing furnace	DeRemer-Blatchford Co.
1	440-volt, 60-cycle, 3-phase	Electric welding machine	Westinghouse Electric Mfg. Co.

Chicago, Milwaukee & St. Paul

1	90-in.	Putnam journal turning and quartering machine	Manning, Maxwell & Moore
1	16-in. by 3-ft.	Pratt & Whitney tool room lathe	Niles-Bement-Pond Co.
1	16-in. by 8-ft.	Engine lathe	Arner Tool Works Co.
1	18-in. by 8-ft.	Engine lathe	Boye & Emmes Co.
1	24-in. by 12-ft.	Engine lathe	Reed-Prentice Co.
1	24-in. by 14-ft.	Engine lathe	Boye & Emmes Co.
1	27-in. by 14-ft.	Engine lathe	Boye & Emmes Co.
1	36-in. by 18-ft.	Engine lathe	Boye & Emmes Co.
1	2-A	Turret lathe	Warner & Swasey Co.
1	9¾-in.	Turret lathe	Gisholt Machine Co.
1	2¼-in.	Turret lathe	Jones & Lamson Machine Co.
1	90-in.	Driving wheel lathe	William Sellers & Co.
1	90-in.	Wheel lathe	Niles-Bement-Pond Co.
1	3-ft.	Radial drill	Cincinnati Bickford Tool Co.
1	6-ft.	Radial drill	Reed-Prentice Co.
1	54-in.	Radial drill	Morris Machine Tool Co.
1	⅜-in.	High speed drill	A. H. S. Manufacturing Co.
1	20-in.	Vertical drill	Superior Machine Tool Co.
1	20-in.	Speed drill	W. F. & J. Barnes Co.
1	36-in.	Drill press	L. E. Snyder & Son
1	42-in.	Drill press	W. F. & J. Barnes Co.
1	10-in.	Pratt & Whitney vertical shaper	Niles-Bement-Pond Co.
1	28-in.	Shaper	Gould & Eberhardt Co.
1	32-in.	Shaper	A. A. Kelly Co.
1	36-in.	Drawcut shaper	Morton Manufacturing Co.
1	36-in. by 36-in. by 12-ft.	Putnam shaper planer	Manning, Maxwell & Moore.
1	32-in.	Newton crank planer	Consolidated Machine Tool Corp.
2	42-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	44-in.	Boring mill	Niles-Bement-Pond Co.
1	No. 36-B.	Automatic gear cutter	Gould & Eberhardt.
1	2-in. by 12-in.	Double end floor grinder	Ransom Manufacturing Co.
1	12-in. by 36-in.	Universal grinder	Thompson Grinder Co.
2	3-in. by 18-in.	Double end floor grinders	U. S. Electrical Tool Co.
1	10-in. by 20-in.	Universal cutter and reamer grinder	Wilmarth & Morman Co.
1	No. 1	Universal grinder	Williams Sellers & Co.
1	3-in.	Portable band saw	Racine Tool & Machine Co.
1	6-in.	Power hack saw	Racine Tool & Machine Co.
1	2-in.	Double head bolt cutter	Acme Machinery Co.
1	600-ton	Wheel press	Chambersburg Engineering Co.
1	200-lb.	Steam hammer	Chambersburg Engineering Co.
1	1,100-lb.	Single frame steam hammer	Chambersburg Engineering Co.
1	1,200-lb.	Steam hammer	Massilion Foundry & Mach. Co.
1	3,300-lb.	Steam hammer	Chambersburg Engineering Co.
1	No. 5	Inclinable punch press	McDonald Machinery Co.
1	8-ft.	Squaring shear	Bertsch & Co.
1	24-in.	Punch and shear	Buffalo Forge Co.
1	48-in.	Single punch and shear	Cleveland Punch & Shear Co.
1	48-in.	Hilles & Jones punch and shear	Consolidated Machine Tool Corp.
1	No. 10½	Badger punch and shear	Rock River Manufacturing Co.
1	14-ft.	Bending roll	Wicks Brothers.
1	¾-in.	Flanger	McCabe Manufacturing Co.

Chicago, Milwaukee & St. Paul

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 204	Power brake	Dreis & Krump Manufacturing Co.
1	No. 3	Steel pressure blower	B. F. Sturtevant Co.
1	Type-B	Electric rivet heater	American Heater Co.
1	5-ft. by 10-in. by 16-ft.	Annealing furnace-car type	DeRemer-Blatchford Co.
1	No. 18	Oil burning forge	Mahr Manufacturing Co.
4		Tool room gas furnaces	Mahr Manufacturing Co.
1	30-in.	Rip saw	Greenlee Bros. & Co.
1	No. 3	Improved 20th Century woodworker	Vonnegut Machinery Co.
1	15-ton	Electric traveling crane	Milwaukee Electric Crane & Manufacturing Co.
3	25-hp.	Fordson tractors	Ford Motor Co.
1	150-amp.	Electric welder	Lincoln Electric Co.
3	300-amp.	Electric welders	General Electric Co.

Chicago Junction

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 10-ft.	Engine lathe	
1	5-ft.	Radial drill press	
1	5-in.	Centering machine	
1	2,000-lb.	Steam hammer	
1	30-in.	Rip saw	
1	810-cu. ft.	Motor driven air compressor	

Chicago, North Shore & Milwaukee

No.	Size and capacity	Type of machine	Builder or dealer
2	3-ton	Thor air hoists	

Chicago, Rock Island & Gulf

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 36-in. by 10-ft.	Engine lathe	E. L. Essley Machinery Co.
1	3-in. by 18-in.	Dry grinder	Ransom Manufacturing Co.
1	1 hp.	Portable grinder with truck	N. A. Strand Co.
1	No. 2	Marvel power hack saw	Sterling Products Co.

Chicago, Rock Island & Pacific

No.	Size and capacity	Type of machine	Builder or dealer
2		Pearce Journal truing machine	W. C. Dunn Co.
2	18-in. by 36-in. by 10-ft.	Rahn & Larmon lathes	E. L. Essley Machinery Co.
1	No. 4	Car wheel lathe	Niles-Bement-Pond Co.
1	24-in. by 36-in.	Cincinnati upright drill	Marshall & Huschart Mchy. Corp.
1		Drill press	Marshall & Huschart Mchy. Corp.
1	36-in. by 36-in. by 12-ft.	Planer	Niles-Bement-Pond Co.
1	48-in. by 48-in. by 12-ft.	Niles planer	Niles-Bement-Pond Co.
1	42-in.	Bullard vertical turret lathe	Marshall & Hutchart Mchy. Corp.
1	48-in.	Car wheel boring machine	Niles-Bement-Pond Co.
1	53-in.	Boring and turning mill	Niles-Bement-Pond Co.
1		Micro internal grinder	Manning, Maxwell & Moore.
4		Portable car wheel grinders	S. W. Fisher.
1	No. 5	Grinder	Manning, Maxwell & Moore.
8	hp., 110-volt	Portable grinders with trucks	N. A. Strand Co.
1	No. 2½	R. K. LeBlond plain milling machine	Marshall & Huschart Mchy. Corp.
1	No. 4	Universal milling machine	Marshall & Huschart Mchy. Corp.
1	Single spindle	Whiton centering machinery	Manning, Maxwell & Moore.
1	No. 1	Marvel power hack saw	Crerar Adams & Co.
1	No. 2	Marvel power hack saw	Crerar Adams & Co.
1	No. 7	Knife cut metal saw	E. C. Atkins Co.
1	4-in. by 6-ft.	Underwood portable cyl. and valve boring bar	E. C. Cummings & Co.
1	No. 137	Squaring shear	H. C. Cannon Co.
1	No. 220	Squaring shear	Robinson, Cary & Sand Co.
1	No. 13	Double punch and shear	Williams, White & Co.
1	15-in. to 36-in.	Punch	Williams, White & Co.
1	No. 5-A	Pressure blower	Buffalo Forge Co
1		Ferguson oil furnace	Railway Materials Co.
1	24-in. by 8-in.	Planer	American Saw Mill Machinery Co.
2	No. 379-B	Automatic vertical mortisers	J. A. Fay & Egan Co.
1	12-in.	Horizontal boring machinery	P. B. Yates Machinery Co.
1	50-ton	Electrically operated drop table	Whiting Corp.
1	14-ft. boom	Electric crane	W. F. Hebard Co.
1	No. 2	Oxygraph cutting machine	Air Reduction Sales Co.
34	300-amp.	Electric welders	U. S. Light & Heat Corp.

Chicago, St. Paul, Minneapolis & Omaha

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 6-ft.	Engine lathe	Cincinnati Lathe & Tool Co.
1	18-in. by 8-ft.	Engine lathe	Lodge & Shipley Mach. Tool Co.

Chicago Short Line

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 10-ft.	American engine lathe	E. L. Essley Machinery Co.
1	No. 1	Sand blast machine	Reliable Sand Blast Mfg. Co.

Chicago, Terre Haute & South Eastern

No.	Size and capacity	Type of machine	Builder or dealer
1	14-in.	Tool grinder	Black & Decker Mfg. Co.
1	25-hp.	Fordson tractor	Ford Motor Co.

Central of Georgia

No.	Size and capacity	Type of machine	Builder or dealer
1	14-in. by 6-ft.	Hendy engine lathe	Walraven Co.
1	18-in. by 8-ft.	Engine lathe	R. S. Armstrong & Bro.
1	16-in.	Portable engine lathe	Fulton Supply Co.
1	2-in.	Warner & Swasey turret lathe	Fulton Supply Co.
1	18-in.-21-in.	Gisholt turret lathe	Moore-Henley Hardware
2	4-ft.	Radial drills	Walraven Co.
1	54-in.	Boring mill	Fulton Supply Co.
1	54-in.	Slab miller	Niles-Bement-Pond Co.
1	58-in.	Niles locomotive rod miller	Niles-Bement-Pond Co.
1	No. 4	Milling machine	Manning, Maxwell & Moore
1		Piston rod grinder	Walraven Co.
2	1-in. by 12-in.	Floor grinders	S. H. Ford & Co.
3	3-in. by 18-in.	Floor grinders	S. H. Ford & Co.
2	6-in. by 6-in.	Peerless hack saws	R. S. Armstrong & Bro.
1	9-in. by 9-in.	Peerless hack saws	D. B. Parker
1		Portable valve seat planer	Walraven Co.
1	2-in.	Triple head bolt cutter	Niles-Bement-Pond Co.
2	No. 2	Two-point rivet heaters	D. B. Parker
1	No. 3	Three-point rivet heater	D. B. Parker
1		Direct connected blower	American Blower Co.
9		Direct connected blowers	W. S. Murrian & Co.
1	No. 2	Band saw filing equipment	Yates American Machine Co.
1	50-cu. ft.	Air compressor	Hardie-Tynes Mfg. Co.
1	1,000-cu. ft.	Air compressor	Bury Compressor Co.
1	200-amp.	Portable electric welder	Westinghouse Electric Mfg. Co.

Central Railroad of New Jersey

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in. by 10-ft. 7-in.	Journal turning and axle lathe	Niles-Bement-Pond Co.
1	3-in. by 3-in.	Universal tool grinder	William Sellers & Co.
1	24-in.	Milling cutter grinder	Ingersoll Milling Machine Co.
1	4-in.	Pipe threader and cutter	Oster Manufacturing Co.
1	2-in.	Pipe threader and cutter	Oster Manufacturing Co.
2	3½-in. by 11½-in.	Marsh portable crank pin machines	Walraven Co.
1	3/16-in.	Campbell nibbling machine	Triplex Machine Co.
1	No. H-83	Tire heating outfit	Hauck Manufacturing Co.
1	1,000-lb.	Air motor hoist	Ingersoll-Rand Co.
1	2-ton, 12 ft. lift	Wright chain hoist	Manning, Maxwell & Moore
2	Type E. W.-6	Electric trucks	Elwell-Parker Electric Co.
3	Type C. K.	Electric trucks	Elwell-Parker Electric Co.
2		Fordson tractors	Ford Motor Co.
3	Type G-1	Steel dump trailers	U. S. Metallic Packing Co.
1	300-cu. ft.	Air compressor	Ingersoll-Rand Co.
1	50-hp.	Motor	Electro-Dynamic Co.
1	2½-k.w.	Motor generator set	General Electric Co.
1	25-k.w.	Motor generator set	Electric Products Co.
1	500-k.w.	G. E. motor generator set	McConway & Torley Co.

Charleston & Western Carolina

No.	Size and capacity	Type of machine	Builder or dealer
1	52-in.	Car wheel boring machine	Consolidated Machine Tool Corp.
1	500-ton	Chambersburg car wheel press	Manning, Maxwell & Moore
1	4,000-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore

Chesapeake & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
3		Betts-Bridgeford jnl. truing lathes	Consolidated Machine Tool Corp.
2	90-in.	Putnam axle jnl. turning lathes	Manning, Maxwell & Moore
1	30-in. by 16-ft.	Ryerson-Conradson engine lathe	Joseph T. Ryerson & Son
3	30-in.	Draw cut shapers	Morton Manufacturing Co.
1	52-in.	Betts car wheel boring machine	Consolidated Machine Tool Corp.
1	8,875-lb.	Internal grinder	Micro Machine Co.
1	2½-in. by 2-in.	Universal grinding machine	William Sellers & Co.
1	3 in. by 3 in.	Tool grinding and shaping machine	William Sellers & Co.
2	36-in. wheel	Drop apron wet tool grinders	Bridgeport Safety Emery Wheel Co.
1		Surface grinder	Hisey-Wolf Machine Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	25-in.	Vertical drill	W. F. & J. Barnes Co.
1	26-in.	Vertical drill	W. F. & J. Barnes Co.
1	42-in.	Vertical drill	W. F. & J. Barnes Co.
1		Internal grinder	Micro Machine Co.
5	No. 506	Double end grinders	Cleveland Armature Works, Inc.
1	No. 1½	Double end grinder	Joseph T. Ryerson & Son.
2	8-in. by 1-in. by ⅝-in.	Cincinnati floor grinders	Robinson, Cary & Sands Co.
1	No. 1½	Tool grinder	Cincinnati Milling Machine Co.
1	6-in. by 6-in.	Metal saw	Peerless Machinery Co.
1	3-in.	Metal cut off machine	Hurlbut, Rogers Machinery Co.
1	No. 42	Portable pipe machine	Oster Manufacturing Co.
1	Series 300, Size 396	Shear	Niagara Machine & Tool Works.
1	No. 3	Blower	Johnson Manufacturing Co.
2	No. 5	Blowers	Johnson Manufacturing Co.
1	1¼-in.	Steel forging machine	The Acme Machinery Co.
1	No. 1230	Stewart Oil furnace	Chicago Flexible Shaft Co.
1	24-in. by 54-in.	Forging furnace	Mahr Manufacturing Co.
1	1½-in.	Post drill	Grerar, Adams & Co.
1	16-in. by 20-in.	Planer and sizer	Yates-American Machinery Co.
1	3¾-in.	Sash, door and cabinet tenoner	Greenlee Bros. & Co.
1	No. 4	Band, scroll and resaw machine	J. A. Fay & Egan Co.
1		Steam driven air compressor	Ingersoll-Rand Co.
1	208-cu. ft.	Air compressor	Ingersoll-Rand Co.
1	3-ton	Overhead traveling crane	Robinson, Cary & Sands Co.
1	10-hp.	Motor	General Electric Co.
1	20-hp.	Motor	Allis Chalmers Manufacturing Co.
1	20-hp.	Motor	Fairbanks-Morse Co.
3	300-amp.	Arc welders	Lincoln Electric Co.
1	400-amp.	Arc welder	Lincoln Electric Co.

Cleveland, Cincinnati, Chicago & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Mounted journel lathe	
1	16-in. by 5-ft.	Engine lathe	
1	36-in. by 18-ft.	Engine lathe	
1	14-in. by 6-ft.	Engine lathe	
1	42-in.	Car wheel lathe	
1	48-in.	Mounted car wheel lathe	
1	24-in.	Vertical drill press	
1	32-in.	Shaper	
1	30-in. by 84-in.	Guide bar grinder	
2	12-in. by 2-in.	Double end grinders	
1	No. 18	Portable grinder	
1	600-ton	Double end wheel press	
1	1,500-lb.	Steam hammer	
1	48-in., 300-600-ton	Duplex car wheel press	
1	24-in.	Punch and shear	
1	48-in.	Punch and shear	
1	2½-in. by 18-in.	Shear	
2		Electric flue welders	
1		Polishing machine	
1	12-in. by 60-in.	Wood lathe	
1	600-C.F.M.	Electric driven air compressor	
1	1,734-C.F.M.	Steam driven air compressor	
1		Coach hoist	
1		Gasoline tractor	
1	3,000-lb.	Tractor	
1	P. C.	Test rack	
1	U.C.	Test rack	

Cincinnati, New Orleans & Texas Pacific

No.	Size and capacity	Type of machine	Builder or dealer
3	200-amp.	Portable electric welders	Westinghouse Electric & Mfg. Co.

Cincinnati Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	48-in.	Car wheel borer	
1	3,000-lb.	Tractor	

Clinchfield

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in.	Niles car wheel lathe	Niles-Bement-Pond Co.
1	4,500-lb.	Single frame steam hammer	Chambersburg Engineering Co.

Columbus & Greenville

No.	Size and capacity	Type of machine	Builder or dealer
1	8-in.	Metal cutting saw	E. C. Atkins & Co.
1	10-in.	Rip saw	Hall & Brown Woodworking Machy. Co.
1	11/16-in.	Double spindle shaper	J. A. Fay & Egan Co.
1	200-amp.	Electric arc welder	Niggs Bros.

No.	Size and capacity	Type of machine	Builder or dealer
1	2½-in.	Automatic cock grinder	Turner Foundry & Machine Co.
1	No. 4	Atkins metal band saw	R. J. Crozier Co.
1	18-in. to 30-in.	Underwood loco. cyl. & dome facer	Manning, Maxwell & Moore
1	10-in. to 36-in.	Portable boring bar	H. B. Underwood Corp.
2	11½-in. to 35-in. dia. by 44 in.	Underwood cylinder and valve chamber boring bars	Manning, Maxwell & Moore
1	48-in., 300-600-ton	Chambersburg hydraulic car wheel press	Manning, Maxwell & Moore
1	100-lb.	Bradley helve hammer	Smith-Courtney Co.
1	4,000-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
1	1½ in.	Heading and forging machine	National Machinery Company
1	2-in. to 6½-in.	Pneumatic flue swedging machine	Joseph T. Ryerson & Son
1		Blower	Johnson Manufacturing Co.
2		Oil burning blacksmith forges	Johnson Manufacturing Co.
14	5-ton	Electric hoists	Chisholm-Moore Manufacturing Co.
6	3,000-lb.	Crane type electric trucks	Elwell-Parker Electric Co.
1	5,000-lb.	Electric truck	Elwell-Parker Electric Co.
4		Electric arc welding sets	General Electric Co.

Chicago & Eastern Illinois

No.	Size and capacity	Type of machine	Builder or dealer
1	6-in. by 11-in. journal, 36-in. wheel	Journal truing and axle lathe	Niles-Bement-Pond Co.
1	36-in., throat	Single end punch and shear	Chambersburg Engineering Co.

Chicago & Northwestern

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Journal & crank pin turning lathe	Niles-Bement-Pond Co.
2	No. 3	Niles axle lathes	Niles-Bement-Pond Co.
2	12-in. by 5-ft.	Engine lathes	Joseph T. Ryerson & Son
2	15-in. by 5-ft.	Portable lathes	Rahn Larmon Co.
1	14-in. by 8-ft.	Monarch engine lathe	Manning, Maxwell & Moore
1	16-in. by 8-ft.	Engine lathe	Manning, Maxwell & Moore
1	18-in. by 8-ft.	Engine lathe	Morris Machine Tool Co.
1	20-in. by 8-ft.	Engine lathe	Cincinnati Lathe & Tool Co.
1	16-in. by 10-ft.	Engine lathe	R. K. LeBlond Machine Tool Co.
1	17-in. by 10-ft.	Engine lathe	Joseph T. Ryerson & Son
1	18-in.	Engine lathe	Joseph T. Ryerson & Son
1	21-in.	Gisholt turret lathe	Neff, Kohlbusch & Bissell Co.
1	90-in.	Tire turning lathe	Niles-Bement-Pond Co.
2	7-ft.	Straight line radial drills	Lee & Clark
1	14-in.	Sensitive floor drill	Joseph T. Ryerson & Son
1	42-in.	Vertical drill press	Federal Machinery Sales Co.
1	50-in.	Aurora drill press	W. F. & J. Barnes Co.
1	D-6	Vertical drill press	E. L. Essley Machinery Co.
1	24-in.	Pattern planer	Rockford Machine & Tool Co.
1	26-in.	Crank planer	Joseph T. Ryerson & Son
1	40-in.	Planer	Joseph T. Ryerson & Son
1	18-in.	Shaper	Joseph T. Ryerson & Son
1	24-in.	Shaper planer	E. C. Cummings Co.
1	52-in.	Single head boring mill	Niles-Bement-Pond Co.
1	52-in.	Vertical boring mill	Neff, Kohlbusch & Bissell Co.
1	10-in.	Universal milling machine	Browne & Sharpe Mfg. Co.
1	Model F. G.	Micro internal grinder	Manning, Maxwell & Moore
1	30-in. by 84-in.	Diamond face grinding machine	E. L. Essley Machinery Co.
2	14-in. by 2-in.	Double end grinders	Ransom Manufacturing Co.
4	18-in. by 2½-in.	Double end grinders	Ransom Manufacturing Co.
1	20-in.	Blount wet tool grinder	Joseph T. Ryerson & Son
1	C.-6-T	Grand Rapids drill grinder	Joseph T. Ryerson & Son
1	2-A.G.	Dunmore bench grinder	Wisconsin Electric Co.
1	18-in. by 2½-in.	Double end dry grinder	Niles-Bement-Pond Co.
1		Dry emery wheel grinder	The Safety Emery Wheel Co.
1	No. 131	Double head emery wheel grinder	Ransom Manufacturing Co.
1		Emery wheel grinder	Ransom Manufacturing Co.
1	6-in. by 6-in.	Racine metal cutting machine	Niles-Bement-Pond Co.
2		Racine metal sawing machines	E. C. Cummings Co.
1	No. 3	Racine metal cutting machine	Niles-Bement-Pond Co.
1	No. 2	Portable crank pin turning machine	H. B. Underwood Corp.
2	4½-in. by 8-ft.	Cylinder boring bars	H. B. Underwood Corp.
1	4-in.	Oster pipe threading machine	Joseph T. Ryerson & Son
1	No. 5½	Pipe threading machine	Scott-Bansback Machinery Co.
1	6-spindle	Staybolt threading machine	Special Bolt Machinery Corp.
4	75-ton	Chambersburg bushing presses	Manning, Maxwell & Moore
4	75-ton	Motor driven rod bushing presses	Southwark Foundry & Machine Co.
1	600-ton	Wheel press	Southwark Foundry & Machine Co.
2	⅝-in. by 7-in. by 96-in.	Spring forming machines	Joseph T. Ryerson & Son
1	No. 3	Rotary bevel shear	Joseph T. Ryerson & Son
1	10-ft.	Squaring shear	Joseph T. Ryerson & Son
1	36-in.	Vertical open gap punch and shear	Cleveland Punch & Shear Co.
1	¾-in.	Pneumatic flanger	McCabe Manufacturing Co.
2	10-ft.	Flanging clamps	New Doty Manufacturing Co.

Chicago & Northwestern

No.	Size and capacity	Type of machine	Builder or dealer
2		Hot saw tube expanders	Joseph T. Ryerson & Son
1	⅝ in. by 10-ft.	Bending roll	Joseph T. Ryerson & Son
1	1¼-in. by 16-ft.	Bending roll	Joseph T. Ryerson & Son
1	⅜-in.	Power bending brake	Chicago Steel Brake Co.
1	8-ft. by 1-in.	Steel cornice brake	Dreis & Krump Manufacturing Co.
1	10-ft.	Cornice brake	Peck, Stow & Wilcox Co.
1	⅜-in. by 12-ft.	Chicago steel power bending brake	Joseph T. Ryerson & Son
1	No. 1-B	Chicago steel bending brake	Joseph T. Ryerson & Son
1	No. 5	Chicago steel bending brake	Joseph T. Ryerson & Son
1	No. 5-B	Chicago steel bending brake	Joseph T. Ryerson & Son
2	No. 19	Portable oil burning rivet forges	Mahr Manufacturing Co.
2	No. 22	Portable oil burning rivet forges	Mahr Manufacturing Co.
1		Post borer	Greenlee Bros. & Co.
2	2½-in.	Hollow chisel mortisers	Greenlee Bros. & Co.
9	16-in.	Swing cut-off saws	Covel Manufacturing Co.
1	16-in.	Portable band saw	J. D. Wallace Co.
5	24-in.	Bench rip saws	Greenlee Bros. & Co.
2	36-in.	Cut-off saws	Greenlee Bros. & Co.
2	6-in.	Bench planers	J. D. Wallace Co.
1	6-in.	Bench planer	Hall & Browne Woodworking Machinery Co.
1	18-in.	Wood turning lathe	Yates American Machinery Co.
1		Shaving conveyor	Chicago Blow Pipe Co.
1		Cushion edge stitcher	Drolls Patent Corp.
1		Carpet sewing machine	Singer Sewing Machine Co.
1	5-ton	Electric traveling crane	Milwaukee Electric Crane & Mfg. Corp.
2	5-ton	Air hoists	Chicago Pneumatic Tool Co.
1	10-ton	Electric hoist	Mercury Manufacturing Co.
1	7-ton	Walking jib crane	Harnischfeger Corporation.
2		Gantry cranes	Milwaukee Electric Crane & Mfg. Corp.
5	3,000-lb.	Electric crane trucks	W. F. Hebard Co.
2	Type C. K.	Electric crane trucks	Elwell-Parker Electric Co.
1	No. 315	Electric elevating truck	Baker, R. & L. Co.
1	Type C. E. A.	Electric crane truck	Automatic Transportation Co.
2	Model T	Ford chassis with three trailers	B. T. Wright, Inc.
2		Air brake test racks	Westinghouse Air Brake Co.
1	No. 6 E. T.	Air brake test rack	Westinghouse Air Brake Co.
1	1,000-cu. ft.	Steam driven compressor	Ingersoll-Rand Co.
1	1,200-cu. ft.	Motor driven air compressor	Bury Compressor Co.
1	1,500-cu. ft.	Motor driven air compressor	Sullivan Machinery Co.
1	1,500-cu. ft.	Steam driven air compressor	Ingersoll-Rand Co.
1	14-in. by 12-in.	Motor driven air compressor	Chicago Pneumatic Tool Co.
1		Oil driven air compressor	Ingersoll-Rand Co.
1		Motor driven air compressor	Ingersoll-Rand Co.
1	300 amp.	Electric welder	U. S. Light & Heat Co.
1	300 amp.	Electric welder	Lincoln Electric Co.
1	600-ton	Driving wheel press	Niles-Bement-Pond Co.
1	100-ton	Bushing press	Chambersburg Engineering Co.
1	No. 6	Single end punch	Beatty Machine & Mfg. Co.
1	No. 7	Single end punch	Beatty Machine & Mfg. Co.
1	No. 31	Multiple punch	Beatty Machine & Mfg. Co.
1	12-in.	Gate shear	Beatty Machine & Mfg. Co.
1	48-in., double end	Hilles & Jones punch shear	Consolidated Machine Tool Corp.
1	30-A	Electric flue welder	Thompson Electric Welding Co.
1	20-A	Electric flue welder	Thompson Electric Welding Co.
1	Type D	Stock adjusting machine	Watson-Stillman Co.
1	No. 227	Steel bending brake	Beatty Machine Co.
1	126-in. by 18-in.	Gap compression riveter	Hanna Engineering Works.
1	No. 1-C	Heating torch	Mahr Manufacturing Co.
1	No. 1	Oil fired rivet forge	Johnson Manufacturing Co.
7	No. 18	Oil fired rivet forges	Mahr Manufacturing Co.
1	14-in. by 20-in.	Timber sizer	J. A. Fay & Egan Co.
1	¼-in. to ¾-in. by 4-in.	Motor driven mortising machine	Greenlee Bros. & Co.
1	No. 226	Hollow mortising machine	Greenlee Bros. & Co.
1	24-in.	Hand jointer	Yates American Machine Co.
1	48-in.	Band saw	J. A. Fay & Egan Co.
1	26-in.	Disk polisher buffer	E. Leitz, Inc.
1	42-in.	Drum sander	American Columbia Mfg. Co.
6	100-ton	Locomotive hoists	Whiting Corp.
1	2½-ton	Traveling hoist	Shepard Electric Crane & Hoist Works.
1	8,500-lb.	Car haul	Mining Machine Co.
3	15,000-lb.	Car hauls	Silent Hoist Co.
1	No. 740	Portable stacking crane	Lewis Shepard Co.
2	1-ton	Pneumatic hoists	Ingersoll-Rand Co.
1	2-ton	Air hoist	Ingersoll-Rand Co.
1	2-ton	Electric monorail hoist	Shepard Electric Crane & Hoist Works.
3	3-T	Triple valve test racks	New York Air Brake Co.
1	3-300-cu. ft.	Electric driven compressor	Ingersoll-Rand Co.
1	1,200-cu. ft.	Air compressor	Ingersoll-Rand Co.
1		Electric truck	Elwell-Parker Electric Co.
2	4,000-lb.	Hand elevating trucks	Plimpton Lift Truck Corp.
1		Fordson tractor	Ford Motor Co.
4	No. 510	Trailer trucks	Mercury Manufacturing Co.
2	3-hp.	Motors	General Electric Co.
1	5-hp.	Motor	Westinghouse Electric & Mfg. Co.
1	5-hp.	Electric motors for shop machinery	Westinghouse Electric & Mfg. Co.
1	10-hp.	Motors for shop machinery	Westinghouse Electric & Mfg. Co.
2	15-hp.	Turntable tractor motors	Westinghouse Electric & Mfg. Co.
1	25-hp.	Turntable tractor motor	Westinghouse Electric & Mfg. Co.
1	25-hp.	Motor for shop machinery	Westinghouse Electric & Mfg. Co.
2	30-hp.	Motors for shop machinery	Westinghouse Electric & Mfg. Co.
1	40-hp.	Motor for Whiting hoist	General Electric Co.
1	Single operator	Portable arc welder	Westinghouse Electric & Mfg. Co.
1	2-operator	Electric welding machine	General Electric Co.
1	350-k.w., a. c.	Generator	Westinghouse Electric & Mfg. Co.
1		Grease cake forming machine	Franklin Railway Supply Co.

Delaware & Hudson

No.	Size and capacity	Type of machine	Builder or dealer
1	45-in.	Journal truing and axle lathe	Consolidated Machine Tool Corp.
1	90-in.	Putnam journal turning lathe	Manning, Maxwell & Moore
1	30-in. by 18-ft.	Engine lathe	Wilson-Brown Corp.
1	54-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	24-in.	Vertical drilling machine	Manning, Maxwell & Moore
3	36-in.	Vertical drilling machines	Manning, Maxwell & Moore
1	36-in.	Shaper	Morton Manufacturing Co.
1	18-in.	Dill slotter	Nazel Engineering & Machine Wks
1	1¼-in. dia. up to 14½ in. dia.	Cylinder grinding machines	Heald Machine Co.
1	18-in. to 100-in.	Sunstrand internal grinder	Manning, Maxwell & Moore
3		Grand Rapids universal grinders	Percy M. Brotherhood & Son
2	½-in. to 4-in.	Oster pipe threaders and cutters	Manning, Maxwell & Moore
5		Forging furnaces	Hauck Manufacturing Co.
1	36-in. by 7 in.	Single surfacer	J. A. Fay & Egan Co.
1	No. 228	Hollow chisel mortiser	Greenlee Bros. & Co.
1	No. H.-87	Parks woodworking machine	Coblentz Tool & Supply Co.
1	36-in.	Cut-off saw	Greenlee Bros & Co.
1	8-in. to 36-in.	Saw sharpener	Oliver Machinery Co.
1	500-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	3,000-lb.	Electric crane truck	Elwell-Parker Electric Co.
1	4,000-lb.	Electric lift truck	Elwell-Parker Electric Co.
1		Electric welder	General Electric Co.

Delaware, Lackawanna & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Putnam journal turning lathe	Manning, Maxwell & Moore
1	14-in. by 6-ft.	American engine lathe	VanDyck Churchill Co.

Escanaba & Lake Superior

No.	Size and capacity	Type of machine	Builder or dealer
1	4-ft.	Radial drill	Bay Verte Machinery Supply Co.

Ft. Worth & Denver City

No.	Size and capacity	Type of machine	Builder or dealer
1	32-in.	Shaper	Gould & Eberhardt
3	No. 31	Dry grinders	Hansom Manufacturing Co.
1	4-spindle	Valve grinding machine	Automatic valve Grinding Machine Co.
1	Model-31	Rip Saw	Hermance Manufacturing Co.
1	Model-453	Cut off saw	Greenlee Bros. & Co.
1	Model, No. 16	Band saw	Oliver Machinery Co.
1	3,000-lb.	Electric crane truck	Elwell-Parker Electric Co.

Georgia Southern & Florida

No.	Size and capacity	Type of machine	Builder or dealer
1	200-amp.	Electric welding machine	Westinghouse Electric & Mfg. Co.

Great Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in.	Screw cutting lathe	South Bend Lathe Works
1	90-in.	Niles driving wheel lathe	Niles-Bement-Pond Co.
1	21-in.	Vertical drill press	Richards Machine Co.
1	54-in.	Car wheel borer	William Sellers & Co.
1	2-in., double head	Bolt cutter	National Machinery Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	100-in.	Betts tire mill	Consolidated Machine Tool Corp.
1	32-in.	Shaper	Columbia Machine Tool Co.
1	¾-in. to 6-in.	Centering machine	D. Nast Machine Co.
1	4-in.	Centering machine	VanDyck Churchill Co.
1	No. 2	Wet and dry grinder	Bridgeport Safety Emery Wheel Co.
1	No. 6	Emery wheel grinder	Bridgeport Safety Emery Wheel Co.
2	3-in.	Drill grinding machines	William Sellers & Co.
1	No. 3	Cylinder facing machine	E. J. Rooksby & Co.
1	No. 2	Pipe cutter	Landis Machine Co.
2	¾-in. to 2-in.	Pipe cutters and threaders	Oster Manufacturing Co.
1	1,500-lb.	Steam hammer	Chambersburg Engineering Co.
1	4,000-lb.	Steam hammer	Chambersburg Engineering Co.
4		Smithing hammers	Chambersburg Engineering Co.
1		Bulldozer	Williams, White & Co.
1	1½-in.	Heading and forging machine	National Machinery Co.
1	1½-in.	National vertical shear	National Roll & Foundry Co.
1	No. 4	Evans comb. shearing and hot punching mach.	Henry Prentiss & Co.
1	9⅞-in.	Riveter	Hanna Engineer Works
1	4-ft. by 6-ft.	Forging furnace	Mahr Manufacturing Co.
1	8-ft. by 10-ft.	Plate furnace	Mahr Manufacturing Co.
1	50-ton	Drop pit table	Whiting Corp.
3	1-ton	Electric hoists	Florandin Equipment Co.
2	4,000-lb.	Electric platform trucks	Elwell-Parker Electric Co.
1	200-amp.	Electric welder	Westinghouse Electric & Mfg. Co.

Denver & Rio Grande Western

No.	Size and capacity	Type of machine	Builder or dealer
2	¾-in. to 2½-in.	Drill grinders	Gallmeyer & Livingston Co.
2	3-in. by 18-in.	Floor grinders	Ransom Manufacturing Co.
1		Universal cutter and grinder	R. K. LeBlond Machine Tool Co.
1	6-in.	Comb. jointer and universal saw	Gallmeyer & Livingston Co.
1	36-in., 14 gage	Gap shear	Peck, Stow & Wilcox
1	36-in.	Foot gap shear	Niagara Machine & Tool Works
1	1-in. to 3-in.	Pipe bending machine	H. B. Underwood Corp.
1	120-in., 14 gage	Chicago steel bending brake	Peck, Stow & Wilcox
1	3-in. by 36-in.	Slip roll forming machine	Niagara Machine & Tool Works
1	24-in. by 8-in.	Single surfacer	Yates-American Machine Co.

Duluth, Missabe & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	50-in.	Portable boring bar	H. B. Underwood Corp.
1	2-in.	Alligator shear	Headley & Whittemore
5	2,000-lb.	Air hoists	Ingersoll-Rand Co.
1	300-amp.	U. S. L. portable arc welding set	W. E. Van Dresser
1	No. 6	Stationary purifier for car journal oil	Sharples Specialty Co.

Duluth & Iron Range

No.	Size and capacity	Type of machine	Builder or dealer
1	20-in. by 3-in.	Flue grinding machine	Robinson Cary Sands Co.
1	No. 6	Stationary purifier for car journal oil	Sharples Specialty Co.

Erie

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Putnam journal truing and quartering machine	Niles-Bement-Pond Co.
1	9¾-in.	Turret lathe	Gisholt Machine Co.
2	90-in.	Driving wheel lathes	Niles-Bement-Pond Co.
1	28-in.	Vertical drill press	Foote-Burt Co.
1	96-in. by 72-in. by 42-ft.	Planer	Niles-Bement-Pond Co.
1	51-in.	Vertical boring mill	Bullard Machine Tool Co.
1		Driving box boring and facing machine	Bullard Machine Tool Co.
1	18-in. by 2½-in.	Electric grinding wheel	Hisey Wolfe Machine Co.
2	20-in., 10-hp.	Swing frame grinders	Diamond Machine Co.
1	48-in.	Car wheel grinder	Norton Co.
1	6-in. by 6-in.	Power hack saw	Peerless Machine Co.
1	4½-in. by 8-ft.	Cylinder boring bar	H. B. Underwood Corp.
1	No. 3	Cylinder facing machine	H. B. Underwood Corp.
1	1¼-in., double	Bolt threading machine	Landis Machine Co.
1	2-in.	Bolt threading machine	National Machine Co.
1	2¼-in., double	Bolt threading machine	National Machine Co.
1	3-in.	Bolt threading machine	Acme Machinery Co.
1	2-in.	Pipe threading machine	Oster Manufacturing Co.
1	No. 2	Pipe cutter	Geist Machinery Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	600-ton, 96-in.	Wheel press	Watson-Stillman Co.
1		Driving box press	Watson-Stillman Co.
1	No. 9	Punch	Beatty Machine & Mfg. Co.
1	No. 11	Punch	Beatty Machine & Mfg. Co.
1	22-in.	Squaring shears	Niagara Machine & Tool Works
2	9⅞-in. by 8½-in. by 11½-in.	Pinch bug riveters	Hanna Engineering Works

Gulf Coast Lines

No.	Size and capacity	Type of machine	Builder or dealer
1	24-in. by 24-in. by 24-in.	Crank planer	Woodward & Powell Planer Co.
1	2-in.	Double head bolt threader	Landis Machine Co.
1	400-ton, 80-in.	Hydraulic driving wheel press	Chambersburg Engineering Co.
1	20-in.	Punch and shear	Henry Pels & Co.

Gulf, Colorado & Santa Fe

No.	Size and capacity	Type of machine	Builder or dealer
1		Journal truing lathe	Manning, Maxwell & Moore
1	21-in. by 10-ft.	Engine lathe	Joseph T. Ryerson & Son
1		Staybolt drilling machine	Stocker, Rumely, Wachs Co.
1		Double end dry emery grinder	Marshall & Huschart Mchy. Co.
1	5,000-lb.	Chambersburg double frame steam hammer	Manning, Maxwell & Moore
1		Flue, rattler, motor driven	Murray Iron Works Co.
12		Blowers	Mahr Manufacturing Co.
5		Oil burning furnaces	DeRemer-Blatchford Co.
1	5-ton	Electric traveling crane	Harnischfeger Corp.
1	125-ton	Electric traveling crane	Harnischfeger Corp.
10	3-phase	Induction motors	Fairbanks, Morse & Co.
2		Motor generators	General Electric Co.

Gulf, Mobile & Northern

No.	Size and capacity	Type of machine	Builder or dealer
1		Mahr flue welding furnace	W. S. Murrian Co.
1	220-volt, 3-phase, 60-cyl.	Gen. Elec. blower	W. S. Murrian Co.
1	20-hp.	Electric turntable tractor	Geo. P. Nichols & Bro.
1	2,000-lb.	Air hoist	Ingersoll-Rand Co.
1	10,000-lb.	Air hoist	Ingersoll-Rand Co.

Gulf & Ship Island

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. by 8-ft.	Engine lathe	Manning, Maxwell & Moore
1	16-in. by 9-ft.	Lehmann engine lathe	Joseph T. Ryerson & Son
1	30-in. by 18-ft.	American engine lathe	E. L. Essley Machinery Co.
2	34-in.	Barnes upright drills	Federal Machinery Sales Co.
1	32-in.	Climax shaper stocker	Rumely-Wachs Co.
1	42-in.	Bullard vertical turret lathe	Marshall & Huschart Mchy. Co.
1	18-in. by 3-in. by 1½-in.	U. S. Elec. Tool Co.'s double end floor grinder	E. C. Cummings Co.
1	2-in.	Acme double bolt cutter	Niles-Bement-Pond Co.
1	No. 16	Pels combination punch, sheet and bar cutter	Neff, Kohlbusch & Bissel Co.
1	20-ft. by 16-in.	Sizer, planer and matcher	Yates-American Machine Co.
1	30-in. by 22-in., single spindle	Vertical wood borer	Greenlee Bros. & Co.
1	2-in.	Car mortiser	Greenlee Bros. & Co.
1		Gainer	Greenlee Bros. & Co.
1	300-amp.	Welding generator	U. S. Light & Heat Corp.

Hocking Valley

No.	Size and capacity	Type of machine	Builder or dealer
2		Pearce journal truing machines	W. C. Dunn Co.
1	18-in. by 8-ft.	Engine lathe	Monarch Machine Tool Co.
1	14-in. by 3-in. by 1¼-in.	Two spindle grinder	U. S. Electrical Tool Co.
1	13-in. by 16-in.	Metal saw	Osborne & Sexton Machinery Co.
1	2-in.	Upsetting forging machine	Ajax Manufacturing Co.
1	3,000-lb.	Electric truck with crane	Elwell-Parker Electric Co.
1	200-amp.	Arc welder mounted on truck	Lincoln Electric Co.

Illinois Central

No.	Size and capacity	Type of machine	Builder or dealer
4	No. 3	Double end axle lathes	Niles-Bement-Pond Co.
2		Axle and journal turning lathes	Niles-Bement-Pond Co.
1	90-in.	Niles locomotive journal lathe	Niles-Bement-Pond Co.
1	90-in.	Niles quartering machine	Niles-Bement-Pond Co.
3		Putnam comb. car journal and axle lathes	Manning, Maxwell & Moore
1		Putnam double end axle lathe	Manning, Maxwell & Moore
3		Pearce journal truing machines	W. C. Dunn Co.
2	16-in. by 5-ft.	Pratt & Whitney tool room lathes	Niles-Bement-Pond Co.
2	11-in. by 6-ft.	LeBlond engine lathes	Federal Machinery Sales Co.

Illinois Central

No.	Size and capacity	Type of machine	Builder or dealer
1	12-in. by 6-ft.	Monarch engine lathe	Manning, Maxwell & Moore
1	12-in. by 6-ft.	Lodge & Shipley engine lathe	Marshall & Huschart Machinery Co.
1	14-in. by 6-ft.	Lodge & Shipley engine lathe	Marshall & Huschart Machinery Co.
1	20-in. by 6-ft. 6-in.	Dresses engine lathe	Manning, Maxwell & Moore
1	16-in. by 8-ft.	Engine lathe	Greaves-Klusman Tool Co.
1	12-in. by 8-ft.	Reed-Prentice engine lathe	Stocker-Rumley-Wach Co.
1	16-in. by 8-ft.	Engine lathe	Greaves-Klusman Tool Co.
3	21-in. by 8-ft.	LeBlond engine lathes	Federal Machinery Sales Co.
2	16-in. by 9-ft.	Lehmann engine lathes	Dale Machinery Co.
3	18-in. by 9-ft.	Lehmann engine lathes	Joseph T. Ryerson & Son
1	18-in. by 9-ft.	Engine lathe	Joseph T. Ryerson & Son
1	24-in. by 9-ft.	Lehmann engine lathe	Joseph T. Ryerson & Son
1	15-in. by 10-ft.	LeBlond engine lathe	Federal Machine Sales Co.
1	16-in. by 10-ft.	Tool room lathe	Hendley Machine Co.
1	16-in. by 10-ft.	Monarch engine lathe	Manning, Maxwell & Moore
1	24-in. by 10-ft.	Engine lathe	Manning, Maxwell & Moore
1	24-in. by 10-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
1	24-in. by 10-ft.	American engine lathe	E. L. Essley Machinery Co.
2	18-in. by 11-ft.	Lehmann engine lathes	Dale Machinery Co.
1	18-in. by 11-ft.	Lehmann engine lathe	Joseph T. Ryerson & Son
2	20-in. by 12-ft.	Engine lathes	Cisco Machine Tool Co.
1	24-in. by 12-ft.	American engine lathe	E. L. Essley Machinery Co.
1	16-in. by 14-ft.	Engine lathe	Hendley Machine Co.
1	24-in. by 14-ft.	American engine lathe	E. L. Essley Machinery Co.
1	30-in. by 16-ft.	Putnam engine lathe	Manning, Maxwell & Moore
1	30-in. by 18-ft.	LeBlond engine lathe	Federal Machinery Sales Co.
1	30-in. by 18-ft.	American engine lathe	E. L. Essley Machinery Co.
1	36-in. by 18-ft.	Engine lathe	Niles-Bement-Pond Co.
2	15-in.	Bardons & Oliver brass lathes	E. C. Cummings Co.
2	18-in.	Bardons & Oliver universal brass lathes	E. C. Cummings Co.
1		South Bend engine lathe	Great Lakes Supply Co.
1		Bench type precision lathe	Manning, Maxwell & Moore
3	2¼-in. by 24-in.	Flat turret lathes	Jones & Lamson Machine Co.
2	3-in. by 36-in.	Flat turret lathes	Jones & Lamson Machine Co.
1	3½-in. by 44-in.	Cincinnati-Acme turret lathe	Marshall & Huschart Machinery Co.
1	1-in. No. 2	Turret lathe	Warner & Swasey Co.
1	No. 4	Turret lathe	Warner & Swasey Co.
1	No. 5	Foster turret lathe	Manning, Maxwell & Moore
1	20-in.	Cincinnati turret lathe	Marshall & Huschart Machinery Co.
1	No. 3	Universal flat turret lathe	Asme Machine Tool Co.
1	21-in.	Gisholt turret lathe	Neff-Kohlbusch & Bissel Co.
1	26-in.	Libbey turret lathe	E. L. Essley Machinery Co.
1	42-in.	Wheel lathe	William Sellers & Co.
1	54-in.	Open center type wheel lathe	Niles-Bement-Pond Co.
2	90-in.	Putnam double head wheel lathes	Manning, Maxwell & Moore
1	90-in.	Driving wheel journal lathe	Niles-Bement-Pond Co.
1	90-in.	Driving wheel quartering mach.	Niles-Bement-Pond Co.
1	100-in.	Betts tire boring and turning mill	E. C. Cummings Co.
1	3-ft.	Cincinnati-Bickford radial drill	Marshall & Huschart Machinery Co.
2	3-ft.	American radial drills	E. L. Essley Machinery Co.
1	4-ft.	Carlton radial drill	Federal Machinery Sales Co.
1	4-ft.	American radial drill	E. L. Essley Machinery Co.
1	4-ft.	Cinn.-Bickford radial drill	Marshall & Huschart Machinery Co.
1	4-ft.	American radial drill	E. L. Essley Machinery Co.
3	5-ft.	American radial drills	E. L. Essley Machinery Co.
1	5-ft.	Carlton radial drill	Federal Machinery Sales Co.
1	5-ft.	Cincinnati-Bickford radial drill	Marshall & Huschart Machinery Co.
1		American frame-drilling machine	E. L. Essley Machinery Co.
1		American boiler plate radial drill	E. L. Essley Machinery Co.
23	12-in.	Albany friction drills	E. L. Essley Machinery Co.
1	20-in.	Barnes vertical drill	E. L. Essley Machinery Co.
6	22-in.	Barnes vertical drill presses	E. L. Essley Machinery Co.
2	24-in.	Barnes vertical drill presses	E. L. Essley Machinery Co.
1	24-in.	Foote-Burt drilling machine	Manning, Maxwell & Moore
1	24-in.	Vertical drill press	Scott-Bansbach Co.
3	24-in.	Mechanics vertical drill presses	Scott-Bansbach Co.
5	25-in.	W. F. & J. Barnes vertical drills	Federal Machinery Sales Co.
1	28-in.	Superior vertical drill	E. C. Cummings Co.
1	36-in.	Barnes, W. F. & J. vertical drill	Federal Machinery Sales Co.
5	single spindle	Henry & Wright sensitive drills	Dale Machinery Co.
1	8-in. single spindle	Pratt & Whitney centering machine	E. L. Essley Machinery Co.
1	12-spindle	Industrial Machine Corp. staybolt driller	E. C. Cummings Co.
1	20-in., 2 spindle	Superior gang drill	E. C. Cummings Co.
1	No. 11-D	Multiple spindle drill press	Marshall & Huschart Machinery Co.
1	5-ft.	Double head centering machine	Hendey Machine Co.

No.	Size and capacity	Type of machine	Builder or dealer
2		Wilmarth & Morman cutter and tool grinders	E. L. Essley Machinery Co.
1	⅜-in. to 3-in.	Gallmeyer & Livingston tool grinder	Stocker-Rumley-Wachs Co.
1		Geometric chaser grinder	Federal Machinery Sales Co.
1		Cleveland reamer grinder	Sterling Products Co.
1		Valve finishing machie	Specialty Bolt Machinery Corp.
1	Type J, Model No. 200	Car wheel grinding machine	Norton Co.
1	18-in.	Portable swing grinder	Excelsior Tool & Machine Co.
1	Type S	Centerless grinder and polisher	Production Machine Co.
1	3-in. by 3-in.	Tool grinder and shaper	William Sellers & Co.
1	¼-in. to 1½-in.	Electric band saw brazer	Oliver Machinery Co.
1	1/16-in. to 1½-in.	Band saw filer and setter	Oliver Machinery Co.
1	1-in. to 6-in.	Band saw sharpener	Machinery Company of America
1	8-in. to 36-in. diameter	Automatic circular saw sharpener	Machinery Company of America
1	36-in.	Precision grinder	Machinery Company of America
1	No. 5	Davis cutter grinding machine	Manning, Maxwell & Moore
1	10-in. by 36-in.	Thompson universal grinder	Manning, Maxwell & Moore
2	No. 1	Peerless surfacing machines	Manning, Maxwell & Moore
2	6-in. by 6-in.	Racine metal cutting saws	E. C. Cummings Co.
2	6-in. by 6-in.	Racine power hack saws	Manning, Maxwell & Moore
3	6-in. by 6-in.	Peerless metal cutting saws	E. L. Essley Machinery Co.
1	9-in. by 9-in.	Peerless metal saw	E. L. Essley Machinery Co.
6	No. 1-A	Hunter metal cut-off saws	Paul H. Wendt
1	No. 276	Espen-Lucas cutting-off saw	Niles-Bement-Pond Co.
1		Morgan Engineering loco valve setting mach.	H. G. Doran & Co.
3		Portable crank pin truing machines	E. J. Rooksby & Co.
1	Multiple spindle	Superheater unit joint grinder	Transportation Devices Corp.
2	1-in.	Acme double bolt cutters	Niles-Bement-Pond Co.
2	1½-in.	Double head bolt cutters	Niles-Bement-Pond Co.
2	2-in.	Acme double bolt cutters	E. L. Essley Machinery Co.
1	2-in.	National nut facing machine	Manning, Maxwell & Moore
3	2-in.	Acme double bolt cutters	Niles-Bement-Pond Co.
1	2½-in.	Acme double bolt cutter	E. L. Essley Machinery Co.
1	4-spindle	Vertical bolt turning machine	Special Bolt Machinery Co.
1	6-spindle	Vertical turning and threading machine	Special Bolt Machinery Co.
2	¼-in. to 2-in.	Chicago pipe threading machines	E. L. Essley Machinery Co.
1	¼-in. to 2-in.	Forbes pipe threader and cutter	E. C. Cummings Co.
1	1-in. to 4-in.	Oster pipe machine	Manning, Maxwell & Moore
1	1¼-in to 6-in.	Bignall & Keeler pipe threader	Manning, Maxwell & Moore
1	30-ton	Horizontal press	Pierce Electric Co.
1	36-in. by 72-in., 50-ton	Forcing press	Lucas Machine Tool Co.
3	100-ton	Chambersburg forcing and straightening presses	Manning, Maxwell & Moore
2	100-ton	Hydro-pneumatic forcing presses	Watson-Stillman Co.
1	100-ton, 2-rod	Hydro-pneumatic forcing press	Watson-Stillman Co.
3	54-in., 500-ton	Hydro-pneumatic wheel presses	Watson-Stillman Co.
1	48-in. 300-600-ton	Duplex car wheel press	Chambersburg Engineering Co.
1	96-in., 800-ton	Niles wheel press	Niles-Bement-Pond Co.
1	1,000-ton	Steam hydraulic forging press	United Engineering & Foundry Co.
1	2,100-ton	Hydraulic flanging and forming press	Southwark Foundry & Machine Co.
4	16-in.	Sheldon hand power arbor presses	Manning, Maxwell & Moore
1	48-in.	Chambersburg car wheel press	Manning, Maxwell & Moore
2	No. 5	Greenerd arbor presses	E. C. Cummings Co.
1	No. 7-A	Niagara power press	E. L. Essley Machinery Co.
3	66-in.	Chambersburg flanging presses	Manning, Maxwell & Moore
1	100-lb.	Bradley helve hammer	Joseph T. Ryerson & Son
1	150-lb.	Bradley helve hammer	Manning, Maxwell & Moore
2	300-lb.	Tool dressing hammers	Erie Foundry Co.
2	1,100-lb.	Steam hammers	Niles-Bement-Pond Co.
1	1,100-lb.	Steam forging hammer	Erie Foundry Co.
1	1,500-lb.	Forging hammer	Erie Foundry Co.
2	1,500-lb.	Steam hammers	Niles-Bement-Pond Co.
1	2,000-lb.	Steam hammer	Erie Foundry Co.
1	3,600-lb.	Steam hammer	William Sellers & Co.
1		Anvil hammer	Blacker Engineering Co.
1	No. 021	Bulldozer	Williams, White & Co.
1	1-in.	Heading and forging machine	Manning, Maxwell & Moore
1	1½-in.	National heading and forging machine	Manning, Maxwell & Moore
1	2-in.	National heading and forging machine	Manning, Maxwell & Moore
1	5-in.	Acme forging and upsetting machine	Niles-Bement-Pond Co.
1	1-in.	Niagara punching press	E. L. Essley Machinery Co.
1	2-in. hole, 1-in. plate	Vertical punch.	Cleveland Punch & Shear Works
1	Size A	Long & Allstatter vertical punch.	Niles-Bement-Pond Co.
1	No. 11	Punching machine	Beatty Machine & Mfg. Co.
1	No. 13	Vertical punch	Williams, White & Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	D-4	Colburn vertical drill press	E. L. Essley Machinery Co.
1	30-in. by 30-in. by 6-ft.	Liberty planer	Stocker Rumley & Wachs Co.
2	30-in. by 30-in. by 10-ft.	Cincinnati planers	Marshall & Huschart Machinery Co.
1	36-in. by 36-in. by 10-ft.	Gray planer	Federal Machinery Sales Co.
1	36-in. by 36-in. by 12-ft.	Planer	Niles-Bement-Pond Co.
1	62-in. by 62-in. by 12-ft.	Cincinnati planer	Marshall & Huschart Machinery Co.
1	84-in. by 36-in. by 40-ft.	Betts planer	E. C. Cummings Co.
1		Plate edge planer	Cleveland Punch & Shear Works
1	12-in.	Pratt & Whitney vertical shaper	Niles-Bement-Pond Co.
1	16-in.	Ohio crank shaper	Joseph T. Ryerson & Son
2	16-in.	Gould & Eberhardt shapers	Marshall & Huschart Machinery Co.
3	24-in.	Ohio crank shapers	Joseph T. Ryerson & Son
1	24-in.	Crank shaper	Hendey Machine Co.
3	30-in.	Draw cut shapers	Morton Manufacturing Co.
1	32-in.	Climax shaper	Stocker-Rumley-Wachs Co.
6	36-in.	Draw cut shapers	Morton Manufacturing Co.
1	20-in.	Slotter	William Sellers & Co.
1	32-in.	Double head frame slotter	Niles-Bement-Pond Co.
1	72-in.	Planing, boring and milling machine	Morton Manufacturing Co.
1	No. 5-A*	Defiance horizontal boring, mil'g, dril'g and tap'g mach.	Manning, Maxwell & Moore
2	No. 32	Horizontal, bor'g dril'g and mil'g machines	Lucas Machine Tool Co.
1	24-in.	Bullard vertical turret lathe	Marshall & Huschart Machinery Co.
4	36-in.	Bullard vertical turret lathes	Marshall & Huschart Machinery Co.
1	42-in.	Car wheel lathe	William Sellers & Co.
2	42-in.	Bullard vertical turret lathes	Marshall & Huschart Machinery Co.
1	44-in.	Bullard driving box borer and facer	Marshall & Huschart Machinery Co.
5	48-in.	Car wheel borers	Niles-Bement-Pond Co.
1	52-in.	Car wheel boring and facing mill	William Sellers & Co.
1	54-in.	Car wheel boring mill	William Sellers & Co.
1	54-in.	Bullard vertical turret lathe	Marshall & Huschart Machinery Co.
1		Boring and facing machine	Marshall & Huschart Machinery Co.
1		Car journal bearing finishing machine	Morton Manufacturing Co.
1		Newton duplex rod boring machine	E. C. Cummings Co.
1		Boring and facing machine	William Sellers & Co.
1	No. 4	Niles car wheel lathe	Niles-Bement-Pond Co.
1	No. 2½	Universal milling machine	E. L. Essley Machinery Co.
1	No. 2-M	Cinn. universal milling machine	Marshall & Huschart Machinery Co.
1	No. 4-A	Universal milling machine	Brown & Sharpe Manufacturing Co.
1	No. 4-B	Universal milling machine	Kearney & Trecker Corp.
1	30-in. by 30-in. by 16-ft.	Horizontal milling machine	Ingersoll Milling Machine Co.
1	54-in. by 30-in. by 16-ft.	Horizontal milling machine	Ingersoll Milling Machine Co.
1	No. 4-B	Plain type milling mach.	Kearney Trecker Corp.
1	42-in.	Adjustable rotary milling machine	Ingersoll Milling Machine Co.
1	54-in.	Adjustable rotary milling machine	Ingersoll Milling Machine Co.
1	No. 4	Cincinnati vertical milling machine	Marshall & Huschart Machinery Co.
2	2½-in.	Mitts & Merrill keyseaters	Manning, Maxwell & Moore
1	14-in. by 22-in.	Lehmann oil grooved milling machine	Joseph T. Ryerson & Son
1	No. 36-B	Gould & Eberhardt automatic gear cutter	Marshall & Huschart Machinery Co.
1	10-in. by 36-in.	Cylindrical grinding machine	Landis Tool Co.
2	8.875-lb.	Internal grinders	Micro Machine Co.
2	No. 33	Abrasive Machine Tool vertical surface grinders	Marshall & Huschart Machinery Co.
2	30-in. by 84-in.	Diamond face grinders	E. L. Essley Machinery Co.
1	No. 2	Peerless surfacing machine	E. L. Essley Machinery Co.
1	No. 2	Sundstrand internal and surface grinder	Manning, Maxwell & Moore
1	No. 5	Safety Emery Wheel swing frame grinder	Scott Bansbach Machinery Co.
1	16-in. to 40-in. by 120-in.	Piston rod grinder	Paducah Iron Co.
6	Model A-18-A	Double end floor grinders	Paducah Iron Co.
2	No. 6	Double end floor grinders	Hisey-Wolf Machine Co.
1	No. 7	Double end floor grinder	Hisey-Wolf Machine Co.
2	No. 2 LBA	Hisey-Wolf bench grinders	Federal Machinery Sales Co.
1	No. 4 LBA	Hisey-Wolf bench grinder	Federal Machinery Sales Co.
5	Type 6WFA	Hisey double end floor grinders	R. L. Barker Co.
1	Type 6 WFA	Hisey double end floor grinder	Federal Machinery Sales Co.
2	Type 7 WFA, 6-hp.	Hisey double end floor grinders	R. L. Barker & Co.
2	Type 7 LA, 5-hp.	Hisey double end floor grinders	R. L. Barker & Co.
15	18-in. by 3-in. by 1½-in.	U. S. Elec. Tool floor grinders	E. C. Cummings Co.
1	18-in. by 3-in. by 1½-in.	U. S. Elec. Tool Co. double end floor grinder	Federal Machinery Sales Co.
4	No. 131	Ransom double end floor grinders	Niles-Bement-Pond Co.
5	No. 51	Oliver drill pointers	Marshall & Huschart Machinery Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	20-in., throat	Punch	Cleveland Punch & Shear Works
1		Single end punch and spacing table	Thomas Spacing Machine Co.
1	½-in.	Quick work rotary shear	Joseph T. Ryerson & Son
1	1½-in.	Long & Allstatter vertical shear	Niles-Bement-Pond Co.
1	2½-in.	Pels bar shear	Neff, Kohlbush & Bissel Co.
1	No. 696	Niagara squaring shear	E. L. Essley Machinery Co.
1		Power bar cutter	Buffalo Forge Co.
1	Type FV-21	Pels bar shear	Neff, Kohlbusch & Bissel Co.
1	Type EFF No. 26	Pels bar cutter	Neff, Kohlbusch & Bissel Co.
1	Size DT	Hilles & Jones vertical shear	Consolidated Machine Tool Corp.
1	No. 3	Rotary bevel shear	Joseph T. Ryerson & Son
2	Type No. 16	Pels comb. punch, shear and bar cutters	Neff, Kohlbusch & Bissel Co.
1	No. 27-UD	Triple comb. punch, slitting shear and bar cutter	Buffalo Forge Co.
1	No. 48	Double end punch and shear	Buffalo Forge Co.
1	Type SDCAP	Combination punch and shear	Joseph T. Ryerson & Son
1	20-in. throat	Lake Erie double end punch	Lee & Clark
1	No. 35, 150-KVA	Swift electric flue welder	Joseph T. Ryerson & Son
1	No. 315	Pneumatic flue welder	Draper Manufacturing Co.
1	5¼-in.	Marshalltown flue lathe	E. L. Essley Machinery Co.
2		Pit type flue cleaners	Joseph T. Ryerson & Son
1	2-in. to 6-in.	Flue welding furnace	Mahr Manufacturing Co.
2	10-ft.	Pneumatic plate flanging clamps	Niles-Bement-Pond Co.
1		Pneumatic flanging machine	McCabe Manufacturing Co.
1	6-in. by 96-in.	Niagara forming machine	E. L. Essley Machinery Co.
1	3-in.	Power bending roll	Buffalo Forge Co.
1		Lake Erie Eng. Corp. plate bending roll	Jas. T. Lee Co.
1		Power bending roll	Buffalo Forge Co.
1	8-ft. 1-in.	Chicago steel hand bending brake	Joseph T. Ryerson & Son
1	12-ft.	Chicago steel power brake	Joseph T. Ryerson & Son
1	No. 516	Chicago steel hand brake	Joseph T. Ryerson & Son
1	18-in. by 84-in. by 30-ton	Hydro-pneumatic riveter	Southwark Foundry & Machine Co.
1	200-ton	Chambersburg hydraulic riveter	Manning, Maxwell & Moore
1	No. 505	Blower	Mahr Manufacturing Co.
2	2-ft. 6-in. by 4-ft.	Forging furnaces	DeReamer-Blatchford Co.
1	2-ft. 6-in. by 4-ft.	Furnace for carbonizing	DeReamer-Blatchford Co.
1	5-ft. 10-in. by 39-ft.	Car bottom annealing furnace	DeReamer-Blatchford Co.
2	6-ft. 7-in. by 8-ft.	Plate heating furnaces	DeReamer-Blatchford Co.
1	4-ft. by 6-ft.	Furnace	DeReamer-Blatchford Co.
1	4-ft. by 6-ft.	Furnace for carbonizing work	DeReamer-Blatchford Co.
1	4-ft. 7-in. by 8-ft.	Furnace	DeReamer-Blatchford Co.
1	18-in. by 30-in. by 9-ft.	Gas fired carbon tool furnace	Mahr Manufacturing Co.
1	18-in. by 24-in.	Gas fired pot furnace	Mahr Manufacturing Co.
1	24-in. by 72-in.	Forging furnace	DeReamer-Blatchford Co.
1	8-in. by 7-in. by 2-in.	Tool dressing furnace	Mahr Manufacturing Co.
1	12-in. by 9-in. by 3-in.	Gas or oil fired tool dressing furnace	Mahr Manufacturing Co.
1	12-in. by 24-in. by 6-in.	Gas fired carbon tool furnace	Mahr Manufacturing Co.
1	12-ft. 10-in. by 15-ft.	Plate heating furnace	DeReamer-Blatchford Co.
1	12-in. by 36-in. by 14-in.	Rectangular gas fired pot	Mahr Manufacturing Co.
2	18-in. by 60-in.	Forging furnaces	DeReamer-Blatchford Co.
2	No. 4-F	Furnaces	DeReamer-Blatchford Co.
3	No. 4	Furnaces	DeReamer-Blatchford Co.
1	No. 4-B	Furnace	DeReamer-Blatchford Co.
2	No. 5-F	Forging furnaces	DeReamer-Blatchford Co.
1	No. 5	Furnace	DeReamer-Blatchford Co.
1		Ring heater	American Hoist & Derrick Co.
1		Double compartment forging furnace	DeReamer-Blatchford Co.
6	2-electrode	Rivet heaters	Humil Corp.
1	Type RRB-12	Electric furnace	General Electric Co.
1	30-in. by 8-in.	Single surfacer	Yates American Machine Co.
1	2-spindle	Shaper	Yates American Machine Co.
1	No. 342	Vertical car tenoner	J. A. Fay & Egan Co.
1	No. 505	Single end-Cabinet tenoner	J. A. Fay & Egan Co.
1	No. 536	Universal horizontal car tenoner	Greenlee Bros. & Co.
2	16-in.	Disc grinders and sanders	J. D. Wallace & Co.
1		Sanding machine	Clark Sanding Machine Co.
1	8-in.	Mortiser	Yates American Machine Co.
1	10-in.	Vertical mortising machine	J. A. Fay & Egan Co.
1	No. 216	Horizontal car mortiser	Greenlee Bros. & Co.
1	No. 232-MB	Vertical hollow chisel mortiser	Greenlee Bros. & Co.
1		Hollow chisel mortiser	Oliver Machinery Co.
2	6-in.	Bench jointers	J. D. Wallace & Co.
1	12-in.	Planer and jointer	J. A. Fay & Egan Co.
1	16-in.	Planer and jointer	Oliver Machinery Co.
1	6-roll, 4-side	Planing, matching and molding mach.	J. A. Fay & Egan Co.

Illinois Central

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 316	Hand planer and jointer	J. A. Fay & Egan Co.
2	6-in.	Wood turning lathes	J. D. Wallace & Co.
1	No. 502	Car gainer	Greenlee Bros. & Co.
1		Universal woodworking machine	Reichman-Crosby Co.
1	Model 3	Woodworker	R. L. Barker & Co.
1	16-in.	Universal woodworker	J. A. Fay & Egan Co.
2	36-in.	Cut-off saws	Greenlee Bros. & Co.
1	No. 374-B	Cutting-off saw	J. A. Fay & Egan Co.
1	24-in.	Medium swing saw	Yates-American Machine Co.
1	No. 3	Rip saw	J. A. Fay & Egan Co.
1	No. 1	Self-feed rip saw	Yates American Machinery Co.
1	36-in.	Rip saw	Greenlee Bros. & Co.
1	48-in. by 81-in.	Self-feed rip saw	Greenlee Bros. & Co.
1	2¼-in.	Universal circular saw	J. D. Wallace & Co.
1	2-in.	Universal circular saw	J. D. Wallace & Co.
1	8-in.	Swing cut-off saw	J. A. Fay & Egan Co.
1	36-in.	Swing cut-off saw	Greenlee Bros. & Co.
1	No. 235	Swing cut-off saw	Yates-American Machinery Co.
2	16-in.	Band saws	J. D. Wallace & Co.
1	36-in.	Band saw	Hall & Brown Woodworking Machine Co.
1	42-in.	Band saw	Yates American Machine Co.
1	No. 282	Band rip saw	Yates-American Machine Co.
9	300-amp.	Portable welding generators	U. S. Light & Heat Corp.
1	200-amp.	Arc welding equipment	General Electric Co.
1	Type B	Hose dismantling and assembling machine	Covington Machine Co.

Indiana Harbor Belt

No.	Size and capacity	Type of machine	Builder or dealer
1	100-cu. ft.	Portable air compressor	
1	360-cu. ft.	Motor driven air compressor	
1	50-hp.	Squirrel cage motor	

International-Great Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	20-in. by 10-ft.	Engine lathe	American Tool Works Co.
1	24-in. by 14-ft.	Engine lathe	American Tool Works Co.
1	16-in. by 18-ft.	Engine lathe	American Tool Works Co.
2	18-in. by 18-ft.	Engine lathes	American Tool Works Co.
1	48-in.	Colburn drill press	Consolidated Machine Tool Corp.
2	24-in. by 24-in. by 24-in.	Heavy duty crank planers	Woodward & Powell Planer Co.
1	42-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	48-in.	Putnam Car wheel borer	Manning, Maxwell & Moore
1	No. 5	Universal miller	Cincinnati Milling Machine Co.
1	No. 1	Universal tool grinder	Wilmarth & Morman Co.
1	2-in. double head	Bolt threader	Landis Tool Co.
2	No. 20	Punch and shears	Henry Pels & Co.
1		Pneumatic flanger	McCabe Manufacturing Co.
1	Type CK	Electric crane truck	Elwell-Parker Electric Co.

Kansas City Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in. by 8-ft.	Boye and Emmes engine lathe	Manning, Maxwell & Moore
1	18-in. by 28-in.	Barnes vertical drill press	English Brothers Machy. Co.
1	24-in.	Columbia shaper	Manning, Maxwell & Moore
2	No. 8	Bridgeport double end grinders	Manning, Maxwell & Moore
1	Type JK	U. S. Electric center grinder	Colcord-Wright Machy. & Supply Co.
1	230 volt a.c.	Portable welding unit	Westinghouse Electric & Mfg. Co.

Lehigh & Hudson River

No.	Size and capacity	Type of machine	Builder or dealer
1	42-in. by 18-ft.	Niles engine lathe	Niles-Bement-Pond Co.
1	5-ft.	Niles radial drill	Niles-Bement-Pond Co.
1	Type W-1-400	Electric hoist	General Electric Co.

Lehigh Valley

No.	Size and capacity	Type of machine	Builder or dealer
2	4-in. by 6-in.	Rooksby portable cylinder boring bars	Manning, Maxwell & Moore
1	1½-in.	Staybolt threading machine	Acme Machine Co.
1	1½-in.	Bolt threading machine	Acme Machine Co.
1	48-in., 500-ton	Car wheel press	Chambersburg Engineering Co.
1	800-ton	Hydro-pneumatic driving wheel press	Chambersburg Engineering Co.

Maine Central

No.	Size and capacity	Type of machine	Builder or dealer
1	10-ton	Shaw electric traveling crane	Manning, Maxwell & Moore

Michigan Central

No.	Size and capacity	Type of machine	Builder or dealer
1		Combination axle lathe	
2	90-in.	Journal lathes	
2		Journal turning machines	
1	21-in. by 20-in.	Lathe	
2	17-in. by 10-ft.	Engine lathes	
1	30-in. by 12-ft.	Engine lathe	
1	36-in. by 18-ft.	Engine lathe	
1	15-in.	Engine lathe	
2	6-ft.	Radial drills	
1	24-in.	Vertical drill press	
2	32-in.	Vertical drill presses	
2	36-in.	Vertical drill presses	
1	42-in. by 36-in. by 16-ft.	3-head adjustable rail milling machine	
1		Milling machine	
1		Surface grinder	
1		Guide bar grinder	
9		Dry grinders	
1		Cutter and tool grinder	
3	36-in.	Metal cut-off saws	
1	2-in.	Pipe threader	
1	4-in.	Pipe threader	
1	6-in.	Pipe threader	
1		Portable pipe threader	
1	3-in.	Bolt centering machine	
1	100-ton	Bushing press	
1		Spring former	
3		Blacksmith hammers	
1	400-lb.	Pneumatic hammer	
1	1½-in.	Forging machine	
1	3-in.	Forging machine	
2	20-in.	Punches	
1	No. 46	Armor plate single end punch	
2		Alligator shears	
2		Double deck oil furnaces	
2	6-ft. 7-in. by 10-ft.	Plate furnaces	
1	30-in.	Wood planer	
1		Wood gainer	
1	24-in.	Rip saw	
1	30-in.	Rip saw	
1	36-in.	Rip saw	
1	36-in.	Rip saw	
3	36-in.	Cut-off saws	
2		Portable sanding machines	
2	10-gal.	Paint spraying machines	
1	2,000-lb.	Jib crane	
1	5-ton	Electric hoist	
1		Pillar jib crane	
9		Combination hoists	
1		Car puller	
1	110-cu. ft.	Air compressor	
1	246-cu. ft.	Air compressor	
1	609-cu. ft.	Air compressor	
1		Gasoline tractor	
2		Portable electric welders	
2		Special dust collecting systems	

Minneapolis, St. Paul & Sault Ste. Marie

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	36-in.	Boring mill	Bullard Machine Tool Co.
1	12-in.	Grinder	U. S. Electric Tool Co.
1	1½-in.	Staybolt threading machine	National Machinery Co.
1	1,500-lb.	Steam hammer	Massillon Co.
1	1½-in.	Punch and shear	Buffalo Forge Co.
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1	1½-in., 3-spindle	Car borer	Greenlee Bros. & Co.
1	24-in.	Saw bench	Greenlee Bros. & Co.
1	24-in.	Swing saw	Yates-American Machine Co.
1	24-in.	Rip saw	Greenlee Bros. & Co.
1	3 U	Air brake test rack	Westinghouse Air Brake Co.

No.	Size and capacity	Type of machine	Builder or dealer
5	4,000-lb.	Platform trailers	U. S. Metallic Packing Co.
7	42-cu. ft., 4,000-lb.	Dump body trailers	U. S. Metallic Packing Co.
1	50-k.w.	Dual drive exciter	Westinghouse Electric & Mfg. Co.

Long Island

No.	Size and capacity	Type of machine	Builder or dealer
1	24-in.	Barnes vertical drill press	Vandyck, Churchill Co.
2	26-in.	Barnes vertical drill presses	Vandyck, Churchill Co.
1	3-in. by 10-in. Dia. 14-in. long	Portable crank pin truing mach.	E. J. Rooksby Co.
1	15-ton	Inverter forcing press	Hydraulic Press Manufacturing Co.
1	25-ton	Inverted bushing press	Hydraulic Press Manufacturing Co.
1	1,500-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
1	16-in., 15-hp.	Punch and shear	Vandyck, Churchill Co.
1	8-in. by 24-in.	Four-sided planer and matcher	Yates American Machine Co.
1	25-ft. by 70-ft.	Gantry crane	Niles Crane Corp.
1		Electrical truck	Elwell-Parker Electric Co.
1	No. 6	Portable purifier for transformer oil	Sharples Specialty Co.

Los Angeles & Salt Lake

No.	Size and capacity	Type of machine	Builder or dealer
1	14-in. by 8-ft.	Monarch portable engine lathe	Manning, Maxwell & Moore
1	36-in. by 8-ft.	Betts engine lathe	Herberts Machinery & Supply Co.
1	18-in. by 10-ft.	Monarch engine lathe	Manning, Maxwell & Moore
1	16-in. by 25-in. by 12-ft.	Monarch gap lathe	Manning, Maxwell & Moore
2	20-in. by 12-ft.	Monarch engine lathes	Manning, Maxwell & Moore
1	24-in. by 14-ft.	Monarch engine lathe	Herberts Machinery & Supply Co.
1	36-in.	Rockford vertical drill press	Herberts Machinery & Supply Co.
1	6-in. by 10-ft.	Underwood portable cylinder boring bar	Herberts Machinery & Supply Co.
1	2-in.	Landis double head bolt threader	Herberts Machinery & Supply Co.
2	No. 2	Victor nut facing machines	Herberts Machinery & Supply Co.

Louisiana & Arkansas

No.	Size and capacity	Type of machine	Builder or dealer
1	¾-in.	Flanging machine	McCabe Manufacturing Co.
1		Planer and moulder	S. A. Woods Co.

Louisville & Nashville

No.	Size and capacity	Type of machine	Builder or dealer
5	15-in. by 6-ft.	Engine lathes	Monarch Machine Tool Co.
1	16-in. by 6-ft.	Engine lathe	Cisco Machine Tool Co.
1	16-in. by 8-ft.	Engine lathe	Monarch Machine Tool Co.
1	22-in. by 14-ft.	Engine lathe	Morris Machine Tool Co.
3	36-in. by 17-in.	Niles engine lathes	Niles-Bement-Pond Co.
1	4-spindle	Screw machine	National Acme Co.
1	36-in. by 36-in. by 12-ft.	Planer	Liberty Machine Tool Co.
1	32-in.	Gould & Eberhardt shaper	Motch & Merryweather Mach. Co.
1	42-in.	Vertical boring mill	E. A. Kinsey Co.
1	73-in.	Niles boring mill	Niles-Bement-Pond Co.
1		Internal and link grinder	Gisholt Machinery Co.
1		Tool grinder	Jas. Clark, Jr.
1	26-in.	Valve seat rotary planer	H. B. Underwood Corp.
1	4½-in. by 6-ft.	Locomotive boring bar	H. B. Underwood Corp.
1	No. 316-A	Pipe threader and cutter	Oster Manufacturing Co.
1	100-ton	Chambersburg bushing press	Manning, Maxwell & Moore
1	Pyramid type	Bending roll	New Doty Manufacturing Co.
2	No. 1	Rotary blowers	P. H. & F. M. Roots Co.
1	3-spindle	Vertical boring machine	J. A. Fay & Egan Co.
1	2-in.	Mortiser and gainer	Greenlee Bros. & Co.
1		Gainer	Greenlee Bros. & Co.
1		Planer and matcher	Hall & Brown Woodworking Machy. Co.
1	No. 70	Tenoning machine	J. A. Fay & Egan Co.
1	36-in.	Cut-off saw	Greenlee Bros. & Co.
1	15-ton, 3-motor	Electric traveling crane	Manning, Maxwell & Moore
1		Steam air compressor	Bury Compressor Co.
1	25-in. by 15½-in. by 18¼-in. by 29¼-in.	Air compressor	Hardie-Tynes Manufacturing Co.
3	25-hp.	Electric motors	Imperial Electric Co.
1	30-hp.	Electric turntable tractor	R. W. Young Manufacturing Co.
2	40-hp.	Electric motors	Imperial Electric Co.
1	50-hp.	Electric motor	Imperial Electric Co.
2	200-amp.	Arc welding sets	Westinghouse Electric & Mfg. Co.
3	36-in.	Oil and waste saving machines	Oil & Waste Saving Machine Co.

Louisville, Henderson & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	100-ton	Hydro-pneumatic bushing press	Chambersburg Engineering Co.

Mississippi Central

No.	Size and capacity	Type of machine	Builder or dealer
1	½-in.	Crank pin turning machine	H. B. Underwood Corp.

Missouri-Kansas-Texas

No.	Size and capacity	Type of machine	Builder or dealer
1	72-in by 72-in. by 24-ft.	Betts planer	Consolidated Machine Tools Corp.
1		Draw cut shaper	Morton Manufacturing Co.
1	48-in.	Putnam car wheel borer	Manning, Maxwell & Moore
1	24-in., by 7-ft.	Bridgeport surface grinder	Manning, Maxwell & Moore
1	24-in. by 8-in.	Sidney single surfacer	Merrit Machinery Co.
1	16-in.	Hand planer and jointer	Hall & Brown Woodworking Mchy. Co.
1	No. 58	Band saw	J. A. Fay & Egan Co.
1	7½-hp.	General Electric air compressor	Corby Supply Co.
1	35-hp.	Planer motor	General Electric Co.

Mobile & Ohio

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 19	Rivet forge	Mahr Manufacturing Co.
1		Shaving exhaust system	Skinner Bros.
1	3-US-B	Test rack	Westinghouse Air Brake Co.
1	400-amp.	Electric welder	Lincoln Electric Co.

Morrissey, Fernie & Michel

No.	Size and capacity	Type of machine	Builder or dealer
1	20-in. by 12-ft.	LeBlond engine lathe	A. R. William Machinery Co.
1	4-ft.	Radial drill	Canadian Machinery Co.
1	34-in.	Colborne boring mill	Oliver Machinery Co.
1	Model AA	Drill and valve grinder	Bilt Rite Equipment Co.
1	8-in. by 8-in.	Power metal saw	B. C. Equipment Co.
1	2½-in. to 4-in.	Byrd tube welder	Walter Byrd Co.
1	10-ton	Overhead crane	Morris Crane Co.
1	12-in. by 12-in.	Air compressor	Oliver Machinery Co.

Missouri Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	45-in.	Betts journal and axle lathe	Niles-Bement-Pond Co.
2	90-in.	Putnam journal, and quartering machines	Manning, Maxwell & Moore
4	19-in.	Engine lathes	R. K. Le Blond Machine Tool Co.
3	19-in.	Engine lathes	Lehmann Machine Co.
1	20-in.	Engine lathe	Monarch Machine Tool Co.
1	20-in.	Toolroom lathe	Lodge & Shipley Machine Tool Co.
1	1¾-in.	Screw machine	New Britain Machine Tool Co.
4	2¼-in. by 24-in.	Hartness flat turret lathes	Jones & Lamson Machine Co.
1	No. 3	Acme flat turret lathe	Acme Machinery Co.
1	3-ft.	Radial drill	American Machine Tool Works Co.
1	4-ft.	Radial drill	Cincinnati-Bickford Tool Co.
1	5-ft.	Radial drill	American Tool Works Co.
2	6-ft.	Radial drills	American Tool Works Co.
1	48-in.	Colburn drill press	Consolidated Machine Tool Corp.
2	No. 20, single spindle	Sensitive drills	Stanley
1	No. 3, four spindle	Vertical drill	Foote-Burt Machine Co.
1	48-in. by 48-in. by 16-ft.	Driving box planer	G. A. Gray Co.
1	32-in.	Newton crank planer	Consolidated Machine Tool Corp.
1	36-in.	Crank planer	Woodward & Powell Planer Co.
1	12-in.	Pratt & Whitney vertical shaper	Niles-Bement-Pond Co.
2	32-in.	Crank shapers	Gould & Eberhardt
1	36-in.	Draw cut shaper	Morton Manufacturing Co.
1	24-in.	Vertical turret lathe	Bullard Machine Tool Co.
2	42-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	42-in.	Niles vertical turret lathe	Niles-Bement-Pond Co.
1	42-in.	Colburn vertical turret lathe	Consolidated Machine Tool Corp.
1	42-in.	Colburn vertical turret lathe	Niles-Bement-Pond Co.
1	36-in. 44-in.	Niles side head boring mill	Niles-Bement-Pond Co.
3	54-in.	Vertical turret lathes	Bullard Machine Tool Co.
1	No. 3	Pratt & Whitney die sinker	Niles-Bement-Pond Co.
1	30-in. by 84-in.	Face grinder	Diamond Machine Co.
1	14-in.	Swing frame grinder	Diamond Machine Co.
1	No. 50	Double end grinder	
10	7½-hp.	Heavy duty double end grinders	U. S. Electrical Tool Co.
1	No. 1	Universal grinder	Gallmeyer & Livingston Co.
1	No. 415	Die grinder	Geometric Tool Co.
2	No. 7	Power hack saws	
1		Valve setting machine	Morgan Engineering Works
2	2-in., double head	Bolt threaders	National Machinery Co.
5	¼-in. to 2-in.	Pipe threaders	Oster Manufacturing Co.
1	1-in. to 4-in.	Pipe threader	Oster Manufacturing Co.

Missouri Pacific

No.	Size and capacity	Type of machine	Builder or dealer
2	1-in. to 6-in.	Pipe threaders	Oster Manufacturing Co.
5	100-ton	Hydraulic bushing presses	Niles-Bement-Pond Co.
1	Type D	Rod bushing press	McArthur
1	No. 2	Spring former	Joseph T. Ryerson & Son
1		Spring band press	Joseph T. Ryerson & Son
1		Spring stripper	Joseph T. Ryerson & Son
1		Combination spring shear and hot punch	Joseph T. Ryerson & Son
1		Combination spring nibbler and trimmer	Joseph T. Ryerson & Son
2	1,500-lb.	Steam hammers	Niles-Bement-Pond Co.
1	Type B	Power hammer	Blacker Engineering Co.
2	1½-in.	Heavy duty forging machines	National Machinery Co.
1	4-in.	Heavey duty forging machine	Ajax Manufacturing Co.
5	No. 20	Combination punch and shears	Henry Pels & Co.
1	3-in., round	Alligator shear	Doelger & Kirsten
3	No. 1,503	Forge blowers	Spencer
1	No. 1,505	Forge blower	Spencer
1	No. 1,510	Forge blower	Spencer
1	No. 327, 5-spindle	Wood borer	Greenlee Bros. & Co.
1	510-A	Vertical mortiser	J. A. Fay & Egan Co.
1	4-side	Wood surfacer	J. A. Fay & Egan Co.
1	No. 430	Combination saw and dado	J. A. Fay & Egan Co.
1	36-in.	Automatic cut-off saw	J. A. Fay & Egan Co.
1	No. 63	Combination arbor saw	Hall & Brown Woodworking Mchy. Co.
1	24-in.	Rip saw	Hall & Brown Woodworking Mchy. Co.
1	60-in.	Double shaving exhauster	Garden City Fan Co.
1	No. 30	Double shaving exhauster	Buffalo Forge Co.
2	15-ton	Gantry cranes	Shaw Crane Co.
1	1-ton	Electric hoist	American Engineering Co.
2	10-ton	Electric hoists	Euclid Crane Co.
6	105-cu. ft.	Air compressors	General Electric Co.
1	143-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	173-cu. ft.	Air compressor	Gardner-Governor Co.
1	445-cu. ft.	Laidlaw air compressor	Worthington Pump & Mchy. Corp.
1	4,000-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	10-hp.	Motor	Westinghouse Electric & Mfg. Co.
1	40-hp.	Motor	General Electric Co.
18	5 to 100-hp.	Motors	Allis-Chalmers Manufacturing Co.
1	15-kw.	Motor generator set	General Electric Co.
3	300-amp.	Arc welding outfits	U. S. Light & Heat Corp.
1	500-kw.	Motor generator set	Allis-Chalmers Manufacturing Co.
2		Nibblers	Campbell

Nashville, Chattanooga & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1		Putnam car axle lathe	Manning, Maxwell & Moore
1	16½-in. by 3-ft. 4-in.	American portable engine lathe	James Supply Co.
1	15-in. by 8-ft.	LeBlond engine lathe	E. A. Kinsey Co.
1	23-in. by 14-ft.	LeBlond engine lathe	E. A. Kinsey Co.
1	5-ft.	Radial drill	Carlton Machine Tool Co.
1	48-in. by 48-in. by 12-ft.	Planer	Liberty Machine Tool Co.
2	48-in.	Putnam car wheel boring machines	Manning, Maxwell & Moore
1	18-in. by 3-in.	Double emery wheel grinder	Hisey-Wolf Machine Co.
1	1½-in.	Acme double bolt cutter	Niles-Bement-Pond Co.
1	400-ton	Chambersburg car wheel press	Manning, Maxwell & Moore
1	48-in.	Hilles & Jones vertical punch and shear	E. A. Kinsey Co.
1	No. 2	Rip saw	J. A. Fay & Egan Co.
1	1½-ton	Electric crane truck	Elwell-Parker Electric Co.
6		Trailers	W. F. Hebard & Co.
1		Shop mule	W. F. Hebard & Co.

New Orleans Great Northern

No.	Size and capacity	Type of machine	Builder or dealer
1	3,000-lb	Electric crane truck	Elwell-Parker Electric Co.

New York Central

No.	Size and capacity	Type of machine	Builder or dealer
1	25-hp.	Heavy duty axle lathe	
1	Double end	Center drive axle lathe	
3	No. 3	Double axle lathes	
2	4-in.	Journal lathes	

No.	Size and capacity	Type of machine	Builder or dealer
2	½-in. to 4-in.	Pipe threader and cutters	
1	1¼-in. to 6-in.	Pipe cutter and threader	
2	2-in.	Pipe threaders	
1	6-in.	Pipe and flue cutter	
1		Portable vise stand and pipe bender	
3	50-ton	Bushing presses	
1	100-ton	Bushing press	
1	800-ton	Hydraulic wheel press	
1	No. 7	Arbor press	
1	2,500-lb.	Single frame steam hammer	
1	3,300-lb.	Steam hammer	
3		Pneumatic hammers	
1		Forging machine	
1	No. 0	Small punch press	
1	Size 4	Hydraulic punch	
1	No. 6	Punch press	
1	⅛-in.	Sheet metal shear	
1	14 U. S., gage	Flat stock cutter	
1	16-BH	Power throatless shear	
1	52-in.	Foot power gap shear	
1		Rotary bevel shear	
2		Blacksmith shop shears	
2	5/16-in.	Nibbling machines	
1	⅛-in.	Cornice brake	
1	48-in.	Cornice brake	
1	¾-in.	Pneumatic flanging machine	
1	48-in.	Slip roll former	
2	9⅞-in. reach, 2½-in. stroke	Compression lever gap riveters	
1	No. 5-E	Blower	
1		Blower and forge	
1	3-ft. by 5-ft.	Hammer furnace	
2	6-ft. 7-in. by 10-in.	Oil plate furnaces	
1	5-spindle	Vertical and radial car borer	
1	No. 369	Planing, matching and molding machine	
1	4-side	Moulding machine	
1	No. 6,100	Direct draft swing saw	
2	14-in.	Circular cross cut saws	
1	16-in.	Buzz saw and joiner	
1	16-ft.	Swing saw table	
1	20-in.	Circular cross cut saw	
1	36-in.	Band saw	
1	9¼-in.	Portable sanding machine	
1	2,000-lb.	Air hoist	
1	3-ton	Pneumatic geared hoist	
3	5-ton	Air motor hoists	
1	½-ton	Lift about hoist	
2	1-ton	Lift about hoists	
1	18-ton	Crane	
1	3,000-lb.	Portable crane truck	
1	4,000-lb.	Lift platform truck	
6	Type C.K.	Electric crane trucks	
4	Type C.L.	Electric crane trucks	
4	Type E.P.	Elevating platform electric trucks	
2	Type WF	Electric platform trucks	
1	P.C.	Brake test rack and timer	
2	3-U. C.	Brake test racks and timers	
1	Pc. No. 50,075	Portable brake test truck	
1	17½-cu. ft.	Air compressor	
2	5-hp.	Motors	
1	10-hp.	Motor	
1	12-hp.	Motor	
1	12.5-kw.	Motor generator set	
2	20-kw.	Motor generator sets	
1	25-hp.	Motor	
1	50-volt	Portable motor generator set	
1	90-hp.	Motor generator set	
1	4-circuit	Truck battery charging outfit	
1	6-circuit	Trucks battery charging outfit	
2		Electric welders	
1		Portable electric welder	
2	2-lead	Welding machines	
1		Hair picker	

New York, Chicago & St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. by 36-in.	Pratt & Whitney engine lathe	Niles-Bement-Pond Co.
1	18-in. by 8-ft.	American engine lathe	National Supply Co.
1	30-in. by 18-in.	Niles engine lathe	Niles-Bement-Pond Co.
1	18-in.	Universal brass lathe	National Supply Co.

No.	Size and capacity	Type of machine	Builder or dealer
3		Journal bearing boring machines	
2	16-in. by 3-ft. 6-in.	Tool room lathes	
1	27-in. by 6-ft.	Engine lathe	
1	27-in. by 14-ft.	Engine lathe	
1	24-in. by 15-ft.	Engine lathe	
1	27-in. by 16-ft.	Engine lathe	
2	11-in.	Portable lathes	
2	16-in.	Engine lathes	
1	17-in.	Gap screw lathe	
1	18-in.	Gap screw lathe	
1	18-in.	Engine lathe	
2	25-in.	Gap lathes	
1	25-in.	Engine lathe	
1	29-in.	Engine lathe	
1		Gap lathe	
1	3-ft.	Radial drill press	
4	4-ft.	Radial drills	
2	5-ft.	Radial drills	
1	6-ft.	Radial drill	
1	12-ft.	Radial drill	
1	20-in.	Vertical drill press	
1	20-in.	Sensitive drill	
15	24-in.	Vertical drill presses	
1	24-in. to 36-in.	Vertical drill press	
1	6-spindle	Staybolt machine	
1	36-in.	Sliding head drilling machine	
1	2-in.	Drill press	
2	32-in. by 32-in.	Crank planers	
1	36-in. by 36-in. by 10-ft.	Planer	
1	28-in.	Shaper	
6	32-in.	Shapers	
1	24-in.	Crank slotting machine	
1	36-in.	Vertical turret lathe	
1	42-in.	Boring and turning mill	
1	44-in.	Boring and turning mill	
3	48-in.	Car wheel borers	
1	50-in.	Horizontal boring machine	
1	52-in.	Car wheel boring and facing mill	
1	No. 4	Universal milling machine	
1	No. 5	Universal milling machine	
1	No. 5-B	Universal milling machine	
1	30-in. by 30-in. by 12-ft.	Slab milling machine	
1	36-in. by 36-in. by 16-ft., 3-head	Adjustable rail milling machine	
2	54-in.	Adjustable rotary milling machines	
1		Rail milling machine	
1	30-in. by 84-in.	Face grinding machine	
2	16-in. by 40-in. by 120-in.	Piston rod grinders	
2	No. 584	Guide bar grinders	
1		Link grinder	
6	18-in. by 3-in.	Emery grinders	
1	5-hp.	Floor grinder	
20		Double end grinders	
3	8-in.	Bench grinders	
4	2-A	Drill grinders	
1	No. 3	Supplemental drill grinder	
1	M-1,005	Automatic key biting machine	
3	10-in. by 36-in.	Universal grinders	
2	Multiple spindle	Superheater unit joint grinders	
2	1½-in.	Parallel grinding units	
1	No. 2	Saw fitting machine	
1	1-hp.	Polishing machine	
1	4-spindle	Automatic cock grinder	
1	¼-in.	Metal band saw	
1	6-in. mill band	Cutting off machine	
1	24-in.	Solid table circular saw	
1		Heavy duty hack saw	
1	4-in. by 8-in.	Boring bar and drill	
2	4½-in.	Portable cylinder boring bars	
1		Valve chamber boring bar	
1	36-in.	Valve seat facer	
2	No. 3	Cylinder and dome facing machines	
1	1½-in.	Staybolt threading machine	
1	2-in.	Bolt threader	
2	2-in., double-head	Bolt cutters	
1	2½-in.	Double bolt threader	
2	2-in., triple head	Bolt threaders	
1	1-in. to 1½-in.	Bolt threader	
1	¼-in. to ½-in.	Pipe threading machine	
1	1-in. to 3-in.	Pipe bending machine	
1	2-in.	Pipe threading and cutting machine	

No.	Size and capacity	Type of machine	Builder or dealer
1	2½-in.	Universal hollow hexagon turret lathe	Warner & Swasey Co.
1	4½-in.	Universal hollow hexagon turret lathe	Warner & Swasey Co.
1		Semi-universal turret lathe	Acme Machine Tool Co.
1	No. 1	American radial drill press	National Supply Co.
1	5-ft.	Sensitive drill press	Fosdick Machine Tool Co.
1	1-in.	Double housing planer	Liberty Machine Tool Co.
1	48-in. by 12-ft.	Gray planer	Strong, Carlisle & Hammond Co.
1	54-in. by 42-in. by 16-in.	Stockbridge shaper	Niles-Bement-Pond Co.
1	26-in.	Stockbridge shaper	Niles-Bement-Pond Co.
1	32-in.	Bullard vertical turret lathe	Motch & Merryweather Machine Co.
1	54-in.		
1	4-B Plain	Milling machine	Kearney & Trecker Corp.
1	12-in. by 32-in.	Gallmeyer & Livingston tool & cutter grinder	National Supply Co.
1	12-in. by 32-in.	Universal grinding machine	Landis Tool Co.
3	3-in.	Drill grinding machines	Oliver Instrument Co.
1	1½-in., 3-spindle	Staybolt threader	Landis Machine Co.
1	1½-in.	Double head staybolt cutter	Acme Machinery Co.
1	75-lb.	Bradley hammer	Strong, Carlisle & Hammond
1	48-in., 200-400-ton	Duplex car wheel press	Chambersburg Engineering Co.
1	3-hole	Flue welding furnace	Railway Material Corporation
1	21-in. by 42-in.	Band saw	J. A. Fay & Egan Co.
1	5-ton	Electric hoist	Chrisholm Moore Co.
1	440-V, 60-cyl.	Portable electric welder	Lincoln Electric Co.

New York, New Haven & Hartford

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Putnam turning lathe	Manning, Maxwell & Moore
1	2-in. to 8-in.	Putnam car axle lathe	Manning, Maxwell & Moore
1	2-in. to 8½-in.	Putnam car axle lathe	Manning, Maxwell & Moore
2	27½-in. by 9-ft.	Putnam double axle lathes	Manning, Maxwell & Moore
1	14-in. by 3-ft.	American engine lathe	Van Dyke-Churchill Co.
1	18-in. by 4-ft.	American engine lathe	Van Dyke-Churchill Co.
1	14-in. by 5-ft.	American engine lathe	Van Dyke-Churchill Co.
1	24-in. by 5-ft.	American engine lathe	Van Dyke-Churchill Co.
1	40-in. by 8-ft.	Engine lathe	Niles-Bement-Pond Co.
1	24-in. by 9-ft.	American engine lathe	Van Dyke-Churchill Co.
1	36-in. by 16-ft.	Niles engine lathe	Niles-Bement-Pond Co.
2	16-in.	LeBond engine lathes	A. Lee Ellis
1	7½-in. by 26-in.	Libbyturret lathe	Van Dyke-Churchill Co.
1	90-in.	Putnam driving wheel lathe	Manning, Maxwell & Moore
2	4-ft.	Morris radial drills	A. Lee Ellis
1	5-ft.	Carlton radial	Hill, Clarke & Co.
1	28-in.	Cincinnati-Bickford drill press	Henry Prentice & Co.
1	4-spindle	Allen vertical drill	Van Dyke-Churchill Co.
1	30-in. by 30-in. by 8-ft.	Planer	Niles-Bement-Pond Co.
1	32-in.	Columbia shaper	Manning, Maxwell & Moore
1	42-in.	Car wheel lathe	William Sellers & Co.
1	48-in.	Putnam car wheel borer	Manning, Maxwell & Moore
1	36-in. by 36-in. by 16-ft. 3 head	Adjustable rail milling machine	Ingersoll Milling Machine Co.
1	42-in. by 30-in. by 16-ft.	Horizontal spindle milling machine	Ingersoll Milling Machine Co.
1	No. 3	Cincinnati milling machine	Henry Prentice & Co.
1	No. 5	Cincinnati plain miller	Henry Prentice & Co.
1	8,875-lb.	Internal grinder	Micro Machine Co.
1	No. 6 (18-in. wheels)	Motor driven floor grinder	Bridgeport Safety Emery Wheel Co.
1	6-in. by 6-in.	Peerless power saw	Van Dyke-Churchill Co.
1	No. 2	Locomotive cylinder facing machine	H. B. Underwood Corp.
1	2-in.	Acme bolt cutter	Van Dyke-Churchill Co.
1	No. 4	Williams pipe cutter	Manning, Maxwell & Moore
1	⅜-in. to 2½-in.	Pipe bending machine	American Pipe Bending Mach. Co.
1	2-in.	Pipe bender	Pedrick Tool & Machine Co.
1	44-in.	Long & Alstatter power punch	A. Lee Ellis
1	No. 1	Long & Allstatter gate shear	Niles-Bement-Pond Co.
1	No. 10½-G.	Niagara power squaring shears	Van Dyke-Churchill Co.
1	No. 372	Niagara squaring shear	Manning, Maxwell & Moore
2	No. 20	Combined punch and shears	Henry Pels Co.
1	B-15	Electric flue welder	Winfield Electric Welding Mach. Co.
1	8-ft. 6-in. by ⅜-in.	Power bending brake	Hill, Clarke & Co.
1	36-in. by 60-in. by 18-in.	Heat treating furnace	Mahr Manufacturing Co.
1	5-spindle	Borer	Greenlee Bros. & Co.
1		Gainer	Greenlee Bros. & Co.
1		Car tenoner	Greenlee Bros. & Co.
1	2½-in.	Mortiser	Greenlee Bros. & Co.
1	36-in.	Rip saw	Greenlee Bros. & Co.
1	2-ton	Electric bridge crane	Shepard Electric Crane & Hoist Co.

New York, New Haven & Hartford

No.	Size and capacity	Type of machine	Builder or dealer
1	10-ton	Electric traveling crane	Niles Crane Corp.
1	20-ton	Electric traveling bridge crane	Niles Crane Corp.
1	30-ton	Electric transfer crane	Industrial Works
1	30-ton	Electric traveling bridge crane	Niles Crane Corporation
1	10-ton	Electric monorail hoist	Shepard Electric Crane & Holst Co.
1	E	Electric hoist	Ingersoll-Rand Co.
4	B	Air motor hoists	Ingersoll-Rand Co.
1	C	Air motor hoist	Ingersoll-Rand Co.
1	C-2	Air motor hoist	Ingersoll-Rand Co.
5	Type TL	Electric tractors	Elwell-Parker Electric Co.
3	Type CK	Electric crane trucks	Elwell-Parker Electric Co.
4	Type T-A	Electric tractors	Elwell-Parker Electric Co.
1	4,000-lb.	Electric elevating truck	Elwell-Parker Electric Co.
1	3,000-lb.	Electric crane trucks	Elwell-Parker Electric Co.
2	5,000-lb.	Electric tractors	Elwell-Parker Electric Co.
3	7-C-4	Jack life trucks	Lewis-Shepard Co.
2	16-in. by 10-in. by 10-in.	Air compressors	Pennsylvania Pump & Compressor Co.
1	24-in. by 14-in. by 18-in.	Air compressor	Chicago Pneumatic Tool Co.
2		Motor generator arc welding sets	Westinghouse Electric & Mfg. Co.
2	WD-12	Motor generator arc welding sets	General Electric Co.
1	No. 4A	Portable purifier for transformer oil	Sharples Specialty Co.

New York, Susquehanna & Western

No.	Size and capacity	Type of machine	Builder or dealer
1	3-T	Triple valve test rack	New York Air Brake Co.

Norfolk Southern

No.	Size and capacity	Type of machine	Builder or dealer
1	5-ft.	Ryerson-Conradson radial drill	Joseph T. Ryerson & Son

Norfolk & Western

No.	Size and capacity	Type of machine	Builder or dealer
2	45-in.	Journal and axle turning lathes	Betts-Bridgeford Machine Co.
2	16-in. by 6-ft.	Engine lathes	Monarch Machine Tool Co.
2	16-in. by 6-ft.	Engine lathes	Greaves Klusman Tool Co.
2	17-in. by 6-ft.	Engine lathes	R. K. LeBlond Machine Tool Co.
4	18-in. by 8-ft.	Engine lathes	Smith Courtney Co.
1	27-in. by 9-ft.	Engine lathe	Niles-Bement-Pond Co.
1	18-in. by 10-ft.	Engine lathe	Bradford Machine Tool Co.
1	2¾-in.	Turret type automatic machine	Cleveland Automatic Machine Co.
1	4½-in.	Full automatic bar machine	Cleveland Automatic Machine Co.
1	5¾-in.	Automatic chucking machine	Potter & Johnson Machine Co.
1	90-in.	Wheel quartering machine	Niles-Bement-Pond Co.
1	3-ft.	Radial drill	Cincinnati-Bickford Tool Co.
1	3-ft.	Radial drill	Fosdick Machine Tool Co.
1	3-ft.	Radial drill	American Tool Works Co.
3	7½-in.	Sensitive drilling machines	Avery Drilling Machine Co.
1	14-in.	Upright sensitive drill	U. S. Machine Tool Co.
4	16-in.	Vertical sensitive drills	Fosdick Machine Tool Co.
1	36-in.	Upright drill	Cincinnati-Bickford Tool Co.
1	36-in. by 36-in.	Planer	Niles-Bement-Pond Co.
1	36-in. by 36-in. by 12-ft.	Maximum service planer	G. A. Gray Co.
1	42-in. by 24-in. by 14-ft.	Switch and frog planer	G. A. Gray Co.
1	48-ft. 2-head	Slotting machine	Consolidated Machine Tool Corp.
1	4½-in.	Horz. boring, drilling and milling mach.	Giddings & Lewis Machine Tool Co.
1	52-in. by 12½-in.	Automatic milling machine	Browne & Sharpe Manufacturing Co.
1	4-ft.	Universal milling machine	Hanson Whitney Machine Co.
1	50-in.	Vertical milling machine	Niles-Bement-Pond Co.
1	14-in. by 2-in.	Suspended type radial grinder	Mummert Dixon Co.
1	12-in. by 2-in.	Double end floor grinder	Marshke Manufacturing Co.
1	12-in. by 2-in.	Double end floor grinder	Diamond Machine Co.
1	12-in. by 2½-in.	Double end floor grinder	U. S. Electric Tool Co.
1	12-in. by 2½-in.	Double end floor grinder	Cleveland Armature Works
1	12-in. by 2½-in.	Double end floor grinder	Bridgeport Safety Emery Wheel Co.
1	12-in. by 3-in.	Double end floor grinder	Bridgeport Safety Emery Wheel Co.
1	14-in. by 2½-in.	Swing frame grinder	Diamond Machine Co.
1	18-in. by 3-in.	Double end floor grinder	Kemp Machinery Co.
6	18-in. by 3-in.	Double end grinders	Hisey Wolf Machine Co.
2	18-in. by 3-in.	Double end floor grinders	Bridgeport Safety Emery Wheel Co.
1		Castillo wheel grinder	E. H. Batchelder Co.
1	1-hp.	Chaser grinder	Landis Machine Co.
1	3-in. by 3-in.	Chapman swing frame grinder	Transmission Ball Bearing Co.
1	12-in. by 2-in.	Buffing and polishing machine	U. S. Electrical Tool Co.
1	5½-in. by 42-in.	Universal and cutter grinder	Smith-Courtney Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	3-U. S.	Triple valve test rack	Westinghouse Air Brake Co.
2	3-T	Triple valve test racks	Westinghouse Air Brake Co.
4	300-amp.	Arc welding machines	Lincoln Electric Co.

Oregon Short Line

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in. by 14-ft.	Engine lathe	Consolidated Machine Tool Corp.
1	42-in. by 20-ft.	Engine lathe	Consolidated Machine Tool Corp.
1	48-in. by 24-in.	Pattern makers gap lathe	Oliver Machinery Co.
1	2½-in.	Automatic turret lathe	Cleveland Automatic Machine Co.
1	No. 3-A	Pratt & Whitney universal die sinker	Niles-Bement-Pond Co.
1	3¼-in.	Horizontal boring, drilling and milling mach.	Lucas Machine Tool Co.
1	20-in.	Grand Rapids cutter and tool grinder	Manning, Maxwell & Moore
1	50-ton	Forcing press	Lucas Machine Tool Co.
1	½-in. to ¾-in.	Buffalo punch and shear	Interstate Machinery & Supply Co.
1	1,500-lb. pressure	Stock adjusting machine	Manning, Maxwell & Moore
2	No. 2	Victor nut facing machines	Herberts Machinery & Supply Co.
2	300-amp, d.c.	Portable welding generators	U. S. Light & Heat Corp.

Oregon-Washington Railroad & Navigation Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	24-in. by 12-ft.	Boye & Emmes engine lathe	Manning, Maxwell & Moore
1	10-in. by 15-in.	Cutter head grinder	J. A. Fay & Egan Co.
1	12-in. by 36-in.	Universal grinding machine	Norton Co.
2	18-in. by 3-ft.	U. S. double end grinders	Harry M. Euler Co.
1	No. 22	Power press	Portland Machinery Co.
1	3-in.	Electric flue welder	Federal Machine & Welder Co.
1	¾-in.	Pneumatic flanging machine	McCabe Manufacturing Co.
2	18-in.	Bench band saws	Portland Machinery Co.
1	30-in. by 20-in.	Band resawing machine	J. A. Fay & Egan Co.
1	2,000-lb.	Roeper electric hoist	Portland Machinery Co.
1	20-kw.	Generating set	Fairbanks-Morse & Co.

Pacific Fruit Express

No.	Size and capacity	Type of machine	Builder or dealer
1		Double axle lathe	Herberts Machinery & Supply Co.
1		Engine lathe	Overkamp Machinery Co.
1		Canedy-Otto bench drill	Herberts Machinery & Supply Co.
1	32-in.	Kelly shaper	Pratt & Whitney Co.
1	48-in.	Car wheel borer	Manning, Maxwell & Moore
1		Saw sharpener	Armstrong-Blum Manufacturing Co.
1		Cutter, reamer and drill grinder	C. F. Bulotti Machinery Co.
1		Automatic band saw resharpener	Overkamp Machinery Co.
1		Motor-driven emery grinder	Herberts Machinery & Supply Co.
1		Car wheel press	Herberts Machinery & Supply Co.
1		Tinner's power splitting shear	Overkamp Machinery Co.
3		Forging furnaces	DeRemer-Blatchford Co.
1		Oil-fired babbitt furnace	Mahr Manufacturing Co.
1		Automatic car gainer	Greenlee Bros. & Co.
1		Motor-driven variety saw	H. H. Plummer & Co.
1		Motor-driven band saw	Overkamp Machinery Co.
1		Air compressor	Ingersoll-Rand Co.
1		Bolt and nut rattler	Louis G. Henes Co.
1		Oil separating and waste washing machine	Overkamp Machinery Co.
1		Hose mounting and clamping machine	New York Air Brake Co.

Panhandle & Sante Fe

No.	Size and capacity	Type of machine	Builder or dealer
2		Double end dry grinders	Marshall & Huschart Machinery Corp.
1		Rip saw	Yates American Machine Co.
1	10-hp.	Induction motor	Graybar Electric Company

Pennsylvania

No.	Size and capacity	Type of machine	Builder or dealer
1	100-in.	Quartering machine	
1		Combination journal and axle lathe	
1		Engine lathe	
1	1½-in.	Universal turret lathe	
3	3¼-in.	Universal hollow hexagon turret lathes	
2	4-spindle	Automatic machines	
3		Screw machines	

No.	Size and capacity	Type of machine	Builder or dealer
2	6-in. to 13-in. dia.	Portable crank pin turning machines	R. J. Rooksby & Co.
1	6-in. to 13½-in. dia.	Portable crank pin turner	H. B. Underwood Corp.
2	¼-in. to 2-in.	Pipe threaders and cutters	Oster Manufacturing Co.
1	2½-in.	Double head threading machine	Landis Machine Co.
1	1¼-in. to 6-in.	Pipe threader and cutter	Oster Manufacturing Co.
1	½-in. to 8-in.	Pipe threader	Toledo Pipe Threading Machine Co.
1	36-in. by 36-in. 50-ton	Power forcing press	Lucas Machine Tool Co.
1	2,000-lb.	Chambersburg steam hammer	Manning, Maxwell & Moore
1	40-holes, 11/16-in.	Hilles & Jones multiple punch	Consolidated Machine Tool Corp.
1	6-in. by 6-in. by ¾-in.	Hilles & Jones gate shear	Consolidated Machine Tool Corp.
1	¼-in. by 4½-in. radius	Throatless rotary shear	Marshalltown Manufacturing Co.
2	36-in.	Squaring shears	Niagara Machine Tool Co.
1	10-gage	Throatless rotary shear	Marshalltown Manufacturing Co.
2	22-gage	Circle shears	Niagara Machine Tool Co.
1	2-in. by 2¼-in. by 2½-in.	Flue roller and welder	Marshalltown-Schaefer Co.
1	⅞-in.	Portable pneumatic riveter	Manning, Maxwell & Moore
1	8-in. sq.	Swing cut-off saw	J. A. Fay & Egan Co.
1	10-in. sq.	Swing cut-off saw	Somers, Fitler & Todd Co.
2	4,000-lb.	Electric double rail trolleys	Shepard Electric Crane & Hoist Co.
1	5-ton	Electric overhead traveling crane	Shepard Electric Crane & Hoist Co.
2	10-ton, 3 motor	Traveling cranes	Niles Crane Corp.
1	10-ton, 3 motor	Electric traveling crane	Northern Engineering Works
1	10-ton, 3 motor	Overhead traveling crane	Whiting Corp.
1	20-gal.	Oil fuel rivet forge	Johnston Manufacturing Co.
4	153-cu. ft.	Air compressors	Chicago Pneumatic Tool Co.
1	452-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	559-cu. ft.	Duplex air compressor	Chicago Pneumatic Tool Co.
2	2,000-lb.	Electric tractors	Baker-Raulang Co.
1	3,000-lb. at 7-ft.	Electric crane truck	Baker, R & L Co.
2	89-in. by 46-in.	Electric trucks	Baker, R & L Co.
2	1,500-lb.	Gasoline tructractors	Clarke Tructractor Co.
2	30-cu. ft.	Tructractors	Clarke Tructractor Co.
37	4,000-lb.	Fifth wheel trailer trucks	Mercury Manufacturing Co.
1	6-in. dia.	Electric welding machine	Thomson Electric Welding Co.
2	No. 22 to No. 3 B&S gage	Spot welders	Thomson Electric Welding Co.
2	12-in.	Belt lacing machines	Peerless Belt Lacing Machine Co.
1	100-journals per hr.	Special circular broaching machine	Morton Manufacturing Co.

Northern Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	24-in.	Putnam double end axle lathe	Manning, Maxwell & Moore
1	90-in.	Putnam journal and quartering machine	Manning, Maxwell & Moore
2	30-in.	Engine lathes	Monarch Machine Tool Co.
1	4-ft. 4½-in.	Radial drill	Cincinnati-Bickford Tool Co.
1	20-in.	Vertical head drill	Niles-Bement-Pond Co.
2	20-in.	Vertical drill presses	Cincinnati-Bickford Tool Co.
1	28-in.	Vertical drill press	Joseph T. Ryerson & Son
1	36-in.	Vertical drill press	Superior Machine Co.
2	24-in. by 12-in.	Driving box borers	Bullard Machine Tool Co.
1	10-in. by 1½-in.	Grinding Machine	
1	14-in. by 2-in.	Grinding machine	Bridgeport Safety Emery Wheel Co.
1	14-in. by 2½-in.	Grinding machine	
1	2-in.	Metal band saw grinder	Wardwell Manufacturing Co.
1	D-2	Saw filing machine	Foley Saw Co.
1	Single spindle	Grinding and polishing machine	
1	6-in. by 6-in.	High speed metal saw	Peerless Machine Co.
1	7-in. by 8-in.	Hack saw machine	E. C. Atkins Co.
1	18-in. by 30-in.	Metal band saw	Armstrong-Blum Manufacturing Co.
2	2-in.	Nipple threading machines	Murchey Machine & Tool Co.
1	2-U	Pipe bender	Wallace Supplies Manufacturing Co.
1	150-ton	Hydraulic driving box press	Watson-Stillman Co.
2	10-ton	Spring assembling tables	Joseph T. Ryerson & Son
2	⅝-in. by 7-in. by 72-in.	Spring forming machines	Joseph T. Ryerson & Son
1	6,000-lb.	Steam hammer	Chambersburg Engineering Co.
1	1-in.	Forging machine	National Machine Tool Co.
1	1½-in.	Forging machine	National Machine Tool Co.
2	24-in., throat	Single end power punches	Hendley & Whittmore
1	¼-in.	Throatless shear	Marshalltown Manufacturing Co.
1	10-ft.	Squaring shear	Bertsch Manufacturing Co.
1	No. 10	Punch and shear	Henry Pels & Co.
2	121-in.	Bending brakes	Dries & Krump Manufacturing Co.
1	145-in.	Bending brake	Dries & Krump Manufacturing Co.
4	No. 1	Rivet forges	Johnston Manufacturing Co.
1	36-in. by 13½-in.	Forging furnace	Johnston Manufacturing Co.
1	3-pot	Babbitt furnace	Johnston Manufacturing Co.
1	16-in. by 26-in.	Swivel cut-off saw	J. A. Fay & Egan Co.
2	5-spindle	Vertical wood borers	J. A. Fay & Egan Co.
2	Size E	Air hoists	Ingersoll-Rand Co.

No.	Size and capacity	Type of machine	Builder or dealer
1		Automatic chucking machine	
1		Car wheel journal lathe	
1		Car wheel turning lathe	
2		Radial drills	
1	4-in.	Vertical drill	
3		Vertical drill presses	
3		Drilling machines	
3		Sensitive drills	
1		Centering machine	
1		Electric crane reamer	
1	3¼-in.	Horizontal boring, drilling and milling mach.	
1	48-in.	Car wheel borer	
1	36-in.-44-in.	Side head boring mill	
2		Milling machines	
1	7,000-lb.	Internal grinder	
8		Grinding machines	
5		Tool grinders	
2		Hack saws	
1		Cylinder facing machine	
5		Boring bars	
1	2-in.	Triple bolt threader	
1	2-in.	Double P. & N. machine	
5	4-in.	Pipe threaders	
1	6-in.	Pipe threader	
1		Hydraulic press	
1		Spring compressing press	
1		Forging machine	
3		Forging machines	
1		Multiple punch spacing table	
1		Horizontal punch	
4		Gang punches	
1		Circle shear and flanging machine	
1		Serpentine shear	
1		Squaring shear	
1		Plate shear	
4		Gate shears	
3		Rotary capping machines	
1	24-in. reach, 18-in. gap, 30-ton	Yoke riveter	
1		Stock adjuster	
3		Flue welding furnaces	
1		Flue polishing machine	
2		Power bending brakes	
1		Slip roll forming machine	
1		Bending roll	
3		Cross cut saws	
2		Tilting furnaces	
3		Rivet heating furnaces	
5		Oil furnaces	
1	5-ft. by 97-ft. 10-in.	Auxiliary hoist	
3		Traveling cranes	
1	20-ton	Locomotive crane	
4	35-ton	Cranes	
3		Electric drop tables	
14		Chain hoists	
59		Jib cranes and hoists	
11		Electric trucks, crane type	
5		Gasoline tractors	
4		Test racks	
11		Air compressors	
4		Generator sets	
8		Electric welding sets	
1		Nibbling machine	
1		Hair picking machine	
1		Waste reclaiming machine	

Peoria & Eastern

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in. by 10-ft.	Tool room lathe	
1	90-in.	Wheel lathe	
1	32-in.	Crank shaper	
1	600-ton	Wheel press	
1	19-ft., 10-ton	Overhead traveling crane	
1	200-amp.	Portable welder	

Pere Marquette

No.	Size and capacity	Type of machine	Builder or dealer
1		Comb. journal and axle lathe	John Bertram & Sons
1	16-in. by 8-ft.	Pratt & Whitney tool makers lathe	Niles-Bement-Pond Co.

Pere Marquette

No.	Size and capacity	Type of machine	Builder or dealer
1	30-in. by 12-ft.	Engine lathe	Wickes Bros.
1	5-ft.	Niles radial drill	Niles-Bement-Pond Co.
1	25-in.	Vertical drill press	Superior Machine Tool Co.
1	32-in.	Draw-cut shaper	Morton Manufacturing Co.
1	48-in.	Car wheel borer	John Bertram & Sons
1	50-in.	Niles boring and turning mill	Niles-Bement-Pond Co.
2	53-in.	Niles boring and turning mills	Niles-Bement-Pond Co.
1	2-in. by 12-in.	Double end emery grinder	Cleveland Armature Works
3	3-in. by 18-in.	Emery grinders	U. S. Electric Tool Co.
1	3/32-in. to 3½-in.	Drill grinder	Gallmeyer & Livingston Co.
1	8-in. by 8-in.	Power hack saw	E. C. Atkins Co.
1	½-in. to 4-in.	Motor driven pipe threader	Oster Manufacturing Co.
1	100-ton	Hydraulic bushing press	Southwark Foundry & Machinery Co.
1	600-ton	Wheel press	Southwark Foundry & Machinery Co.
1	¾-in.	Portable flanger	McCabe Manufacturing Co.
1	14-in. by 18-in.	Low pressure oil furnace	Railway Materials Co.
1	18-in. by 72-in.	Low pressure oil furnace	Railway Materials Co.
1	20-in.	Rip saw	Yates-American Machine Co.
1	20-in.	Cut-off saw	Yates-American Machine Co.
1		Universal wood worker	Cresent Machine Co.
1	300-cu. ft.	Air compressor	Westinghouse Traction Brake Co.
1	350-cu. ft.	Air compressor	Ingersoll-Rand Co.
1	1-ton	Electric hoist	Detroit Hoist & Machine Co.

Pittsburgh & Lake Erie

No.	Size and capacity	Type of machine	Builder or dealer
1	100-in.	Vertical boring and turning mill	
1	No. 8	Metal cutting saw	
1	5-in. by 8-ft.	Portable boring outfit	
1	¼-in. to 2-in.	Single head pipe threader	
1	½-in. to 2-in.	Roller pipe cutter	
1		Straightening press	
1	4-in., round	Alligator shear	
1	30-in.	Shear	
1	36-in. reach, 18-in. gap, 30-ton	Yoke riveter	
1	8-in. reach, 8¼-in. gap, 10-in. cyl.	Pinch bug riveter	
1	8-in. by 14-in. by 30-in.	Double deck steel furnace	
1	14-in.	Universal saw bench	
1	3,000-lb.	Electric crane truck	
1		Air hose clamp cutting machine	
1		Air hose stripping machine	

Pittsburgh & Shawmut

No.	Size and capacity	Type of machine	Builder or dealer
1	22-in.	Rotary valve seat facer	E. J. Rooksby & Co.
1	2-in.	Angle cock grinder	Turner Foundry & Machine Co.

Portland Terminal

No.	Size and capacity	Type of machine	Builder or dealer
1	48-in.	Putnam wheel lathe	Manning, Maxwell & Moore
1	400-ton	Chambersburg wheel press	Manning, Maxwell & Moore
1	No. 3	Pressure blower	B. F. Sturtevant Co.

Quebec Central

No.	Size and capacity	Type of machine	Builder or dealer
1	1½-in., single head	Acme staybolt cutter	John Bertram & Sons

Reading Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Niles loco. axle journal turning lathe	Niles-Bement-Pond Co.
4	4-in.	Vertical drill presses	Baker Bros.
1	48-in.	Niles car wheel borer	Niles-Bement-Pond Co.
1	9-in. to 12-in.	Driving box boring and facing machine	William Sellers & Co.
1	400-lb.	Portable frame jaw miller	Micro Machine Co.
1		Castillo car wheel grinder	S. W. Fisher
1	4½-in. by 8-ft.	Portable cyl. boring and facing mach.	H. B. Underwood Corp.
1	1-in. to 4-in.	Pipe threader and cutter	Oster Manufacturing Co.
1	600-lb.	Single frame steam hammer	Chambersburg Engineering Co.
1	¾-in.	Pneumatic flanger	McCabe Manufacturing Co.
2	24-in. by 14-in. by 18-in.	Air compressors	Chicago Pneumatic Tool Co.
4	25-ton	Overhead traveling cranes	Niles-Bement-Pond Co.

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 3-A	Milling machine	Brown & Sharpe Manufacturing Co.
1	36-in.	Vertical turret lathe	Bullard Machine Tool Co.
2	44-in.	Putnam boring mills	Manning, Maxwell & Moore
3	3½-in. by 18-in.	Emery grinders	Diamond Machine Tool Co.
1	12-in. by 20-in.	Crank pin turner	Walraven Co.
1	4½-in. by 6-ft.	Cylinder boring bar	H. B. Underwood Corp.
2	100-ton	Hydraulic bushing presses	R. D. Wood & Co.
1	400-ton	Double end wheel press	Chambersburg Engineering Co.
1	121-in.	Pexto cornice brake	Manning, Maxwell & Moore
2	12-in. by 7-in. by 10-in.	Air compressors	Chicago Pneumatic Tool Co.
2	10-in. by 17-in. by 10-in. by 12-in.	Air compressors	Chicago Pneumatic Tool Co.

Southern

No.	Size and capacity	Type of machine	Builder or dealer
1		Special boring & facing machine	William Sellers & Co.
1	No. 1	Combined saw filing and setting machine	E. C. Atkins & Co.
1	No. 211	Straight knife grinder	Hall & Brown Woodworking Machine Co.
1	No. 297	Cutter head grinding machine	J. A. Fay & Egan Co.
1	No. 421	Grindstone	J. A. Fay & Egan Co.
1	No. 948	Automatic circular saw sharpener	J. A. Fay & Egan Co.
1	No. 70	Single end tenoning machine	J. A. Fay & Egan Co.
1	No. 232-MC	Hollow chisel car mortiser	Greenlee Bros. & Co.
1	No. 284	Automatic hollow chisel mortiser	Wysong & Miles Co.
1	No. 330, 5-spindle	Vertical and radial car borer	Greenlee Bros. & Co.
1	No. 356	Automatic cut-off	Greenlee Bros. & Co.
1	No. 478	Double arbor universal saw bench	Greenlee Bros. & Co.
1	No. 97-A, 6-roll	Planer and matcher	Newman Machine Co.
1	No. 171, 6-roll, 4-side	Planing machine	J. A. Fay & Egan Co.
1	No. 326	Molding machine	J. A. Fay & Egan Co.
1	10-in., 4-side	Molding machine	J. A. Fay & Egan Co.
1	No. 316	Hand planing and jointing machine	J. A. Fay & Egan Co.
1	No. 345	Band sawing machine	J. A. Fay & Egan Co.
1	No. 427	Heavy self-feed rip saw	Greenlee Bros. & Co.
1	No. 503	Iron frame rip saw	J. A. Fay & Egan Co.
1	No. 252	Friezing and shaping machine	J. A. Fay & Egan Co.
1	No. 515	Universal woodworker	J. A. Fay & Egan Co.
1	No. 502-P	Automatic corrugating machine	Greenlee Bros. & Co.
1	No. 399	Double drum sand papering machine	J. A. Fay & Egan Co.
1	No. 443-C	Double end pattern maker lathe	J. A. Fay & Egan Co.
1	No. 90	Planing mill exhauster	B. F. Sturtevant Co.
1	No. 7	Power feed rod machine	J. A. Fay & Egan Co.
1	200-amp.	Portable electric welder	Westinghouse Electric & Mfg. Co

Southern Pacific System

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Putnam wheel lathe	Manning, Maxwell & Moore
1	90-in.	Niles wheel lathe	Niles-Bement-Pond Co.
1	No. 2	Vertical drilling machine	Detroit Machine Tool Co.
1	9-in.	Milwaukee shaper	International Machine Tool Co.
1	26-in.	Rockford shaper	Joseph T. Ryerson & Son
1	36-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	14-in.	Internal and link grinder	Gisholt Machine Co.
1	16-in. by 96-in.	Piston rod grinder	Cincinnati Milling Machine Co.
1	44-in.	Car wheel grinder	Norton Co.
1	1¼-in.	Racine rail cutting machine	Smith-Booth Usher Co.
1	42-in.	Power squaring shears	Niagara Machine & Tool Works
1	No. 11	Special bar cutter	Buffalo Forge Co.
1	10-hp.	Billet shear	Pratt & Whitney Co.
1	7-in. by 72-in.	Universal spring forming machine	Joseph T. Ryerson & Son
1	Model K	Automatic filer, setter and jointer	J. A. Fay & Egan Co.
1	½-ton	Air hoist	Ingersoll-Rand Co.
1	1-ton	Air hoist	Independent Pneumatic Tool Co
1	2-ton	Air hoist	Ingersoll-Rand Co.
2		Fordson tractors	Ford Motor Co.
1	No. 202	DeLaval oil purifier	DeLaval Separator Co.

Spokane, Portland & Seattle

No.	Size and capacity	Type of machine	Builder or dealer
1	2½-in. to 10-in.	Williams vertical cyl. grinder	Foster Machine Co.
1	20, 40 and 60-ton	Hydraulic spring banding pres-s	Watson-Stillman Co.
1	100-ton	Hydraulic forcing press	Hydraulic Press Manufacturing Co.
1	2,000-lb.	Gas tractor	Reliance Trailer & Truck Co.
1	550-cu. ft.	Air compressor	Westinghouse Traction Brake Co.
1	5-hp.	Induction motor	General Electric Co.
1	20-hp.	Induction motor	General Electric Co.

No.	Size and capacity	Type of machine	Builder or dealer
2	50-ton four motor	Overhead traveling cranes	Niles-Bement-Pond Co.
1		Electric truck	Crescent Truck Co.
25		Fordson tractors	Ford Motor Co.
29	Type W	Shop trailers	Electric Wheel Co.
25	Model B	Shop trailers	Whitehead & Kales Co.
1	No. 6ET	Air brake test rack	Westinghouse Air Brake Co.
1	3-hp.	Electric motor	Westinghouse Electric & Mfg. Co.
15	5-hp.	Electric motors	Westinghouse Electric & Mfg. Co.
10	7-hp.	Electric motors	Westinghouse Electric & Mfg. Co.
7	10-hp.	Electric motors	Westinghouse Electric & Mfg. Co.
6	15-hp.	Electric motors	Westinghouse Electric & Mfg. Co.
4	20-hp.	Electric motors	Westinghouse Electric & Mfg. Co.
2	25-hp.	Electric motors	Westinghouse Electric & Mfg. Co.
1	30-hp.	Electric motor	Westinghouse Electric & Mfg. Co.
1	35-hp.	Electric motor	Westinghouse Electric & Mfg. Co.
33		Special dust collecting systems	Kirk & Blum Manufacturing Co.

Richmond, Fredericksburg & Potomac

No.	Size and capacity	Type of machine	Builder or dealer
4	20-in.	Engine lathes	American Tool Works Co.
1	24-in.	Engine lathe	American Tool Works Co.
1	36-in.	Engine lathe	American Tool Works Co.
1	C7	Turret lathe	New Brittan Machine Tool Co.
1	32-in.	Shaper	Gould & Eberhardt
1	22-in.	Sensitive drill	Leland Gifford Machine Co.
1	34-in.	Vertical drill press	W. F. & J. Barnes Co.
1	No. 6	Emery grinder	Bridgeport Safety Emery Wheel Co.
1	15-ton	Bushing press	Lucas Machine Tool Co.
1	100-ton	Bushing press	Watson-Stillman Co.
1	24-in.	Rip saw	Greenlee Bros. & Co.
1	42-in.	Band saw	J. A. Fay & Egan Co.
1	10-ton	Traveling Crane	Shaw Crane Co.
2		Drop pit tables	Whiting Corp.

Rutland

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in. by 18-ft.	Engine lathe	Niles-Bement-Pond Co.
1	36-in.	Snyder vertical drill press	Manning, Maxwell & Moore

St. Louis-San Francisco

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Driving wheel and journal truing machine	
1	32-in.	Shaper	
1	48-in.	Car wheel boring machine	
2	2-in.	Pipe threaders	
1	4,000-lb.	Steam hammer	
1	8,000-lb.	Steam hammer	
1		Marvel pressure blower	
1	14,000-cu. ft.	Pressure blower	
1		Sand blasting machine	
1	10-ton	Traveling electric crane	
1	3¼-hp.	Motor	
1	6-hp.	Motor	
1	10-hp.	Motor	
2	30-hp.	Motors	
2	40-hp.	Motors	
1	50-hp.	Motor	
1		Electric welder	

St. Louis-Southwestern

No.	Size and capacity	Type of machine	Builder or dealer
2	No. 10	Rivet forges	Johnston Manufacturing Co.
1		Variety woodworker	American Wood Working Machine Co.
1	200-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.

Seaboard Air Line

No.	Size and capacity	Type of machine	Builder or dealer
1	18-in.	Engine lathe	Monarch Machine Tool Co.
1	20-in.	Engine lathe	Monarch Machine Tool Co.
2	30-in.	Engine lathes	Monarch Machine Tool Co.
1	15-in.	Brass lathe	Bardons & Oliver Co.
1	34-in.	Radial drill	W. F. & J. Barnes Co.
1	32-in.	Shaper	Columbia Machine Tool Co.
1	36-in.	Draw-cut shaper	Morton Manufacturing Co.

Terminal Railroad Association of St. Louis

No.	Size and capacity	Type of machine	Builder or dealer
1	30-hp.	Induction motor	General Electric Co.
1	15-in. by 10-ft.	Lodge & Shipley engine lathe	Elliott & Stephens Co.
1	3¼-in.	Turret lathe	Foster Machine Co.
1	3-ft.	Radial drill	Carlton Machine Tool Works
1	No. 263	Geared drilling and tapping machine	Barnes Drill Co.
1	32-in.	Crank shaper	Consolidated Machine Tool Corp.
1	24-in.	Vertical turret lathe	Bullard Machine Tool Co.
1	72-in.	Vertical boring and turning mill	Gisholt Machine Co.
1	30-in.	Squaring shear	Concord-Wright Machine & Supply Corp.
1	No. 14-iron	Ring and circle shear	Niagara Machine Tool Works
1	48-in., throat	Combination punch and shear	Henry Pels & Co.
1	⅝-in. by 7-in. by 72-in.	Elliptic spring forming machine	Joseph T. Ryerson & Son
1	¾-in.	Pneumatic flanging machine	McCabe Manufacturing Co.
2	300-amp	Portable electric arc welders	General Electric Co.

Texarkana & Ft. Smith

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 8	Double end wheel grinder	Manning, Maxwell & Moore

Texas & Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Putnam turning and quartering machine	G. F. Cotter Supply Co.
1	No. 3	Axle lathe	Niles-Bement-Pond Co.
1	18-in. by 8-ft.	Lodge & Shipley engine lathe	Huey & Phillip Hardware Co.
1	16-in.	Lodge & Shipley engine lathe	Huey & Phillip Hardware Co.
1	20-in.	Monarch engine lathe	G. F. Cotter Supply Co.
1	20-in.	Lodge & Shipley engine lathe	Huey & Phillip Hardware Co.
2	30-in. by 14-ft.	Engine lathes	Niles-Bement-Pond Co.
1	3-in. by 36-in. by 15-in.	Flat turret lathe	Jones & Lamson Machine Co.
1	No. 4	Car wheel lathe	Niles-Bement-Pond Co.
1	3-ft.	Cincinnati-Bickford radial drill	Huey & Phillip Hardware Co.
1	5-ft.	Radial drill press	Niles-Bement-Pond Co.
2	36-in.	Vertical drills	P. H. McArdle Co.
2	No. 7	Bar single spindle drills	Niles-Bement-Pond Co.
1	No. 2	Avey vertical drill press	Woodward Wight Co.
3	14-in.	Sensitive drills	Huey & Phillip Hardware Co.
1	36-in. by 36-in. by 36-in.	Woodward & Powell planer	G. F. Cotter Supply Co.
1	42-in. by 24-in. by 16-ft.	Gray special frog planer	Peden Iron & Steel Co.
2	32-in.	Columbia shapers	G. F. Cotter Supply Co.
1	54-in.	Adjustable rotary milling machine	Ingersoll Milling Machine Co.
1	58-in.	Niles locomotive rod miller	Niles-Bement-Pond Co.
1	No. 5	Cincinnati milling machine	Huey & Phillip Hardware Co.
1	36-in.-44-in.	Niles side head boring mill	Niles-Bement-Pond Co.
1	84-in.	Boring and turning mill	Niles-Bement-Pond Co.
1	44-in.	Boring and facing machine	William Sellers & Co.
1	No. 4	Niles car wheel lathe	Niles-Bement-Pond Co.
1	8,875-lb.	Micro internal grinder	G. F. Cotter Supply Co.
1	8-spindle	Automatic valve grinding machine	Automatic Valve Grinding Works
1		Semi-Automatic valve finishing machine	Special Bolt Machining Corp.
1		Gisholt universal tool grinder	P. H. McArdle Co.
1	14-in.	Diamond swing frame grinder	P. H. McArdle Co.
5	Type 2	Floor grinders	Bridgeport Safety Emery Wheel Co
2	2-in.	National double head bolt cutters	G. F. Cotter Supply Co.
1	No. 4	Harrington stay bolt threader	Woodward Wight Co.
1	No. 736	Pipe threader	Huey & Phillip Hardware Co.
1	No. 330	Pipe machine	Jarecki Manufacturing Co.
2	100-ton	Bushing presses	Niles-Bement-Pond Co.
1	No. 2	Guillotine type bar shear	Niles-Bement-Pond Co.
1	Type No. G 20	Pels punch and shear	G. F. Cotter Supply Co.
1		Automatic flue swedging machine	Joseph T. Ryerson & Son
1	36-in. by 24-in.	Yoke riveter	Hanna Engineer Works
1	9-ft. by 17-ft.	Annealing furnace	DeRemer-Blatchford Co.
2	2-in.	Mortisers	Greenlee Bros. & Co.
2	36-in.	Rip saws	Greenlee Bros. & Co.
2	24-in.	Cut-off saws	Greenlee Bros. & Co.
3	36-in.	Band saws	Oliver Machine Co.
2	Motor driven	American grindstones	Yates American Machine Co.
1	Type X.P.V-3	Air compressor	Ingersoll-Rand Co.
2		McCormick tractors	International Harvester Co.
3		Welding machines	General Electric Co.
3		Portable welding machines	Westinghouse Electric & Mfg. Co.

Union

No.	Size and capacity	Type of machine	Builder or dealer
1	100-ton	Hydraulic press	Manning, Maxwell & Moore
1	3,000-lb.	Electric truck	Elwell-Parker Electric Co.

Union Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 3	Double end axle lathe	Niles-Bement-Pond Co.
1	26½-in.	Micro internal grinder	Manning, Maxwell & Moore
2	86-in.	Bridgeport face grinders	Manning, Maxwell & Moore
1	24-in. by 4-in.	Ransom dry grinders	Hendrie & Bolthoff Mfg. Co.
1	24-in. by 4-in.	Ransom dry grinder	Niles-Bement-Pond Co.
1	10-in. by 36-in.	Surface grinding machine	Thompson Grinder Co.
2	18-in. by 3-in.	Double end grinders	U. S. Electric Tool Co.
1	1/16-in. to 1½-in.	Band saw filing and setting machine	Black Diamond Saw & Machine Works
1	⅜-in. to 2½-in.	Pipe bender	American Pipe Bending Machine Co.
3		Rivet forges	Mahr Manufacturing Co.
1	No. 461	Swiveling swing cut-off saw	J. A. Fay & Egan Co.
1	8-in.	Universal woodworker	J. A. Fay & Egan Co.
2	3,000-lb.	Electric crane trucks	Elwell-Parker Electric Co.
1		Fordson tractor	C. E. Paulson Motor Co.
1	336-cu. ft.	Air compressor	Worthington Pump & Machinery Co.
1	16-in. cyl.	Champion hair picker	Lassky, White & Coolidge Corp.

Virginian

No.	Size and capacity	Type of machine	Builder or dealer
1	No. 18	Power hack saw	E. C. Atkins Co.
1	600-ton	Chambersburg wheel press	Manning, Maxwell & Moore
1	5-ton	Electric traveling crane	Northern Engineer Works
1	10-ton	Electric traveling crane	Harnischfeger Sales Co.
1	15-ton	Electric traveling crane	Northern Engineer Works

Wabash

No.	Size and capacity	Type of machine	Builder or dealer
1	90-in.	Niles quartering machine	Niles-Bement-Pond Co.
1	18-in.	Engine lathe	Monarch Machine Tool Co.
1	90-in.	Niles driving wheel lathe	Niles-Bement-Pond Co.
12	3-ft.	Radial drills	American Tool Works Co.
2	21-in.	Sensitive drill presses	Elliott-Stephens Machine Co.
1	34-in.	Vertical drill press	W. F. & J. Barnes Co.
2	⅞-in. cup, 12-in. reach	Sensitive drill presses	Avey Machine Tool Co.
1	32-in.	Crank shaper	Blackman-Hill & Co.
1	32-in.	Shaper	American Tool Works
1	20-in.	Dill slotter	Nazel Engineering & Machine Works
2	48-in.	Car wheel borers	Niles-Bement-Pond Co.
1	5-hp.	Radius link grinder	Gisholt Machine Co.
1	No. 1 (12-in. wheels)	Motor driven floor grinder	Bridgeport Safety Emery Wheel Co.
2	3-in.	Drill grinders	William Sellers & Co.
1		Chaser grinder	Landis Machine Co.
1	26-in. to 40-in.	Cylinder and dome facer	H. B. Underwood Corp.
1	3¼-in. by 6-ft.	Portable valve chamber boring bar	H. B. Underwood Corp.
1	1-in.	Triple bolt threader	National Machine Co.
1		Pneumatic pipe bending machine	Bass Foundry & Machine Co.
1	36-in., 100-ton	Hydro-pneumatic bushing press	Chambersburg Engineering Co.
1	400-ton	Wheel press	Niles-Bement-Pond Co.
1	6,000-lb.	Niles steam hammer	Niles-Bement-Pond Co.
1	6-in.	Flue welder	Thomson Electric Welding Co.
1	42-in. by 18-in. by 2½-in.	Oil forging furnace	Johnston Manufacturing Co.
1	3-hp.	Belt sander	Yates American Machine Co.
1	6-in.	Band saw stretcher	Machine Company of America
8	1 gal.	Pneumatic paint spraying machines	Binks Spray Equipment Co.
2	1-ton	Chain hoists	Yale & Towne Manufacturing Co.
1	2-ton	Electric crane truck	Elwell-Parker Electric Co.
2	170-cu. ft.	Air compressors	Worthington Pump & Machinery Co.
1	250-cu. ft.	Air compressor	Leader Iron Works
1	250-cu. ft.	Air compressor	Worthington Pump & Machinery Co.
1	350-cu. ft.	Air compressor	Chicago Pneumatic Tool Co.
1	350-cu. ft.	Air compressor	Ingersoll-Rand Co.
1	3-hp.	Electric motor	Graybar Electric Co.
2	15-hp.	Electric motors	General Electric Co.
1	20-hp.	Electric motor	Wagner Electric Co.
2	300-amp.	Electric welders	U. S. Light & Heat Corp.

Western Pacific

No.	Size and capacity	Type of machine	Builder or dealer
1	2½-in.	Blacksmith hammer	Blacker Engineering Co.
1	3-electrode	Electric rivet heater	Humil Corp.
2	3-T	Triple valve test racks	Westinghouse Air Brake Co.
1	3-U.S.	Universal valve test rack	Westinghouse Air Brake Co.

Wheeling & Lake Erie

No.	Size and capacity	Type of machine	Builder or dealer
1	16-in.	Engine lathe	Motch & Merryweather Machine Co.
2	20-in.	Engine lathes	Motch & Merryweather Machine Co.
2	28-in.	Shapers	Motch & Merryweather Machine Co.
1	42-in.	Bullard vertical turret lathe	Motch & Merryweather Machine Co.
1	2-hp.	Medium duty grinder	Dillon Electric Co.
1	3½-in. to 11½-in.	Portable crank pin turning machine	Walraven Co.
1	¾-in.	Pneumatic flanging machine	McCabe Manufacturing Co.
1	200-amp.	Portable arc welder	Westinghouse Electric & Mfg. Co.
2	300-amp.	Portable arc welders	Lincoln Electric Co.

Yazoo & Mississippi Valley

No.	Size and capacity	Type of machine	Builder or dealer
1	36-in.	Draw-cut shaper	Morton Manufacturing Co.
1	18-in. by 3-in. by 1½-in.	U. S. Elec. Tool double end floor grinder	E. C. Cummings Co.

Handling repaired and tested triple valves

By J. P. Stewart

General supervisor air brakes, Missouri Pacific

To sacrifice operating efficiency by careless handling and thus to shorten the service life of triple valves between repair periods is, to say the least, a wasteful practice. Many test rack operators and triple valve repair men have been unjustly accused of inefficient work when the real trouble is neglect to protect the valve from dirt entering through the port openings after cleaning and testing. Many times triple valves, after being cleaned and tested, are damaged because during the journey from the test room to the place where they are installed on the car, precaution against dirt and foreign matter entering the valves through the port and pipe openings has not been taken. The operating efficiency of triple valves and in fact the entire brake is sacrificed when foreign matter is permitted to enter the valve.

To protect cleaned and tested triple valves from dirt while they are in transit from the air brake room to the car, the flange and pipe ports should be closed. This can be accomplished by two methods: either by closing the ports with wooden plugs and blocking, or by sealing the ports with metal thread protectors and a shipping cap. The external threads on the check valve case are protected by the metal thread protector and the triple valve flange face is also insured against damage by the metal shipping cap.

Objections to the wooden plugs and blocks are the liability of the former to become loosened and lost, and of the latter to be broken during shipment. Furthermore, the wooden blocking when warped fails to prevent

the entrance of dirt between the block and the bolting flange face. Wooden plugs in the check valve case opening fail to protect the external threads from damage during handling. On the other hand, metal thread protectors and metal shipping caps furnish protection from dirt and protect the external thread on the check valve case. Metal protectors and caps are easily applied and with reasonable care will last indefinitely. Experience has shown that their use is the most economical and satisfactory method of protection that can be provided.

When shipping type L triple valves, the safety valve should be removed to avoid breakage and the safety valve opening should be plugged to protect against the entrance of dirt. Properly designed wooden boxes should be provided for the protection of the equalizing and emergency portions of the universal and control valves during shipping.

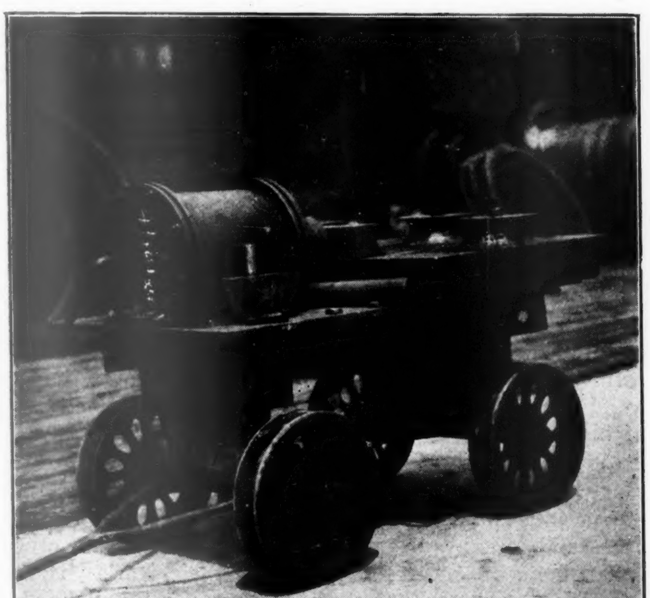
Portable device for testing superheater units

By H. C. Spicer

Erecting shop foreman, A. C. L., Waycross, Ga.

IT is not unusual to remove superheater units from a locomotive located some distance away from the test rack. When such a situation occurs, it is necessary to move the units to the test rack, which requires considerable time and labor. One method of overcoming such a situation is to bring the testing device to the locomotive.

A testing device of this type is shown in the illustration.



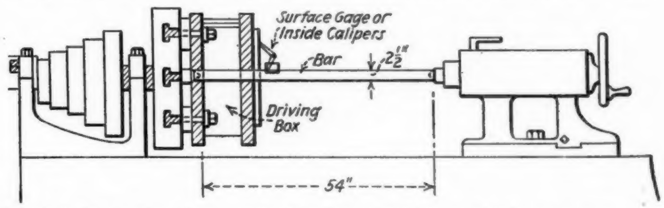
It requires about 25 min. to bend a set of arch tubes on this machine

It consists of a small hand pump and two hose lines, one for air and one for water. The two ends of the hose are fitted to a cap which is clamped to the unit joints by a 1-in. bolt. The flow of air and water is controlled by two globe valves. The units are filled with water which is raised to a pressure of 300 lb. or more by using the hand pump. After the test is completed, the air pressure is turned into the units to blow out the water.

Boring driving boxes on a lathe

By B. G. Miller

THERE are many small engine terminals that are not equipped with a boring mill for doing such jobs as boring out driving boxes. When such is the case, driving boxes are usually bored out on a lathe of about a 36-in. size. Shown in the sketch is a bar applied between the centers of a lathe, the use of which greatly facilitates the work of centering a driving box on the lathe chuck or face plate. It is intended to relieve the



Sketch showing the method of centering a driving box on a lathe

operator of the work of having to turn the large face plate over to get the driving box in center position.

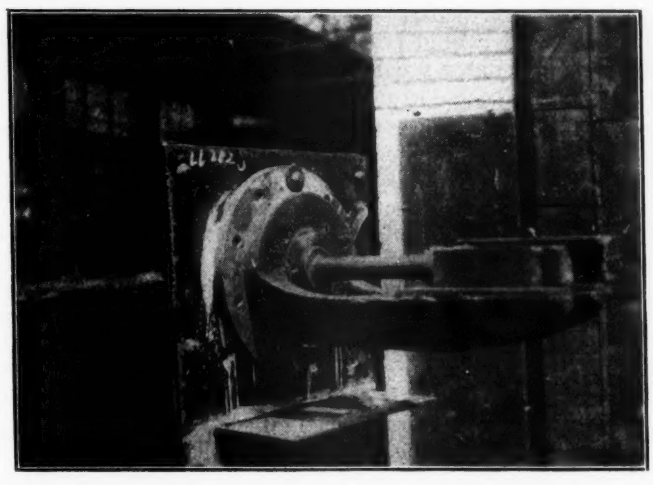
The bar is 54 in. long, 2½ in. in diameter and has taper holes in each end that fit on the lathe centers. The operator can easily center a driving box by measuring from the bar to the inside surface of the driving box with a surface gage, or pair of inside calipers. By the use of this bar a driving box can be set up and ready to bore in 6 min.

Stand for holding back valve chamber heads

By J. H. Hahn

Machine shop foreman, Norfolk & Western, Portsmouth, Ohio

ON certain classes of locomotives the back valve chamber head supports the valve stem crosshead and guides. When assembling and fitting the guides and lining the valve stem crosshead to the guides in the shop



A stand used for assembling and fitting back valve chamber head guides

a stand such as shown in the illustration will be found useful for holding the back valve chamber heads.

This stand is constructed of two pieces of 12-in. channel iron on which is mounted a piece of ⅜-in. boiler

plate. Two 6-in. I-beams form the supports for the upright at one end. Another piece of 3/8-in. boiler plate is riveted to the two pieces of I-beam. Holes are then drilled in the plate to suit the various bolt circles on the back valve chamber heads. The heads are bolted in position and the guides lined and all the bolts and cotter keys applied. A mandrel, which is turned on one end to fit in the stuffing box counterbore in the head is placed in position and then a dummy crosshead, machined to the standard dimensions for a particular class of locomotive, is placed on the other end of the mandrel. The guides are then tested for alinement thus insuring prompt installation at the locomotive.

Two braces of suitable dimensions are riveted, one on each side, to strengthen the construction of the stand. A 6-in. hole is also cut in the back of the upright plate to enable the workman to remove and replace the mandrel and tighten or loosen the nut that holds it in place. A drawer can be supplied under the stand for tools, bolts, nuts and cotter keys.

Shop scheduling at Sacramento*

Schedule system applied at Southern Pacific shops increases both car and locomotive output materially

By H. C. Venter

Shop superintendent, Southern Pacific, Sacramento, Cal.

ABOUT two years ago the Southern Pacific shop management began to formulate plans whereby they could not only be more certain of a constant output of locomotives and cars, but could regulate this output so that it would be evenly distributed over any given period.

The first step toward establishing this schedule system was to determine the minimum amount of time required to pass a locomotive or car through the shops for designated repairs. Primarily it became necessary to decide upon a key department or gang to which the work of all other departments could be co-ordinated. This "key" was decided to be the boiler shop for locomotives and the paint shop for cars.

Time schedules were then determined for the various classes of repairs as applied to the different classes of locomotives and cars. A schedule supervisor, detailed from the general foreman's office, divided locomotive and car repairs into from 20 to 30 sections, assigning each section to the department in which the work was to be performed. Sufficient time was allotted each department to perform the work, which they were required to pass on to the next department by a specified time. In this way all work would reach the erecting shop in orderly sequence on dates previously determined.

The shop foreman was thus relieved of responsibility for planning the work through the various departments and found more time for the supervision of his men.

Development of this plan has provided the schedule supervisor with complete data which enables him to set correct dates for all classes of repairs on all classes of equipment.

Our records show that previous to the adoption of the schedule system and working under old methods, a Class 2 engine would be in the shop a minimum of 60 days. We are now certain that when an engine enters the shop for repairs it will be out on the date predetermined when it is first placed on schedule.

Practically the same procedure is followed in the case of car equipment, except that car work is broken up into fewer items than is locomotive work.

During 1923 Sacramento general shops turned out 78 Class 2 repairs at an average of 54 working days per engine. In 1924, under the schedule system, 92 Class 2 repairs were turned out at an average of 41 working days per engine. In 1925 we turned out 75 Class 2 repairs at an average of 42½ working days per engine. This included five Mallet engines. Schedules on other classes of repairs, ranging from Class 1 to Class 5, have been lessened in proportion.

The reduction in number of days locomotives are in the shop naturally reduces the cost of making repairs. We have found it to represent a saving of from $2,000 to $3,000 per engine. During the year 1924, when not using the schedule system, 179 passenger cars, receiving general repairs were turned out at an average of 36 days per car. At the present time all classes of passenger cars are turned out at an average of twenty-five days per car.

When our schedule system was inaugurated it encountered more or less objection from the various supervisors in both departments. They felt it to be a reflection on their ability and feared that some of their responsibility was being encroached upon, but after the system had been thoroughly explained and had been in operation for several months, it won the support of the entire organization. The system at once indicated that many of the delays for which certain foremen had previously been held responsible were not originating in their department. The schedule board indicates to everyone at a glance just where any delay is actually occurring, and relieves foremen of many details with which they formerly had to contend. The time thus gained is used to advantage by each foreman in directing the activities of his men.

One of the advantages of scheduling locomotives and cars through the shop is that materials will come from the various shops in a continuous flow, making it unnecessary for any of the men or foremen to visit other departments in order to co-ordinate their work. If the schedule is followed properly, all materials will be delivered to the various departments in ample time for them to complete their work so that the engine may be placed in service according to the date indicated on the schedule.

The full co-operation of the storekeeper is an important factor in the successful operation of the schedule system (and it can be said in passing that we have this co-operation at Sacramento), as he and his department form one of the important spokes in the wheel.

The fact that at Sacramento we have several manufacturing industries, such as iron, steel and brass foundries, etc., also works advantageously for the schedule system. These manufacturing plants were originally

* Abstract of an address before the Pacific Railway Club.

provided to offset delays due to the distance of our railroad from the usual sources of supply. Had these facilities not been provided, long delays would constantly have resulted in obtaining materials from eastern markets.

Oftentimes after a locomotive is stripped and parts are subjected to hammer test, flaws are found in frames, castings, wheel centers, etc., which could not have been discovered by ordinary inspection while the locomotive was in service. The need for such new castings could not therefore be anticipated without the carrying of a very large and expensive inventory covering all the many parts and materials which might be required. With our manufacturing facilities at hand, however, we are able to place orders for the required parts immediately, and have them completed and on hand as demanded by the requirements of the schedule.

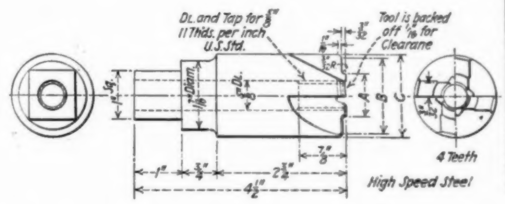
Our manufacturing plants also enable us to utilize the large amount of scrap accumulated on the railroad, and which can be worked up at more of a profit than would be realized if the material were sold as scrap. Our foundries are particularly advantageous in the manufacture of cylinders and other large items for the marine equipment of the company, as there are no foundries on the Pacific Coast, except ours, sufficiently large to handle such castings.

We have found that our schedule system promotes efficiency, brings about greater economy in which both the railroad and the public share, and insures dependable service. These three items, to a greater degree than any other feature in railroad operation, denote real progress.

Tools for counterboring crown sheet holes

By E. A. Miller

TWO tools for counterboring holes in crown sheets are shown in the drawings. One of the tools is designed to be used with an air motor and the other to be used on a drill press. Referring to Fig. 1, the drill press tool has a standard No. 3 Morse taper shank and the socket is drilled for a No. 5 standard taper pin. The collar fits over the socket and is held by the taper pin. The end of the socket is drilled and tapped for the screw which holds the cutter to the socket. The cutter is of high-

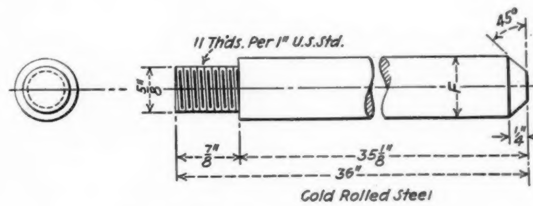


Size of Crown Bolt	A	B	C
1"	61/64"	1 5/8"	1 3/4"
1 1/16"	1 1/64"	1 5/8"	1 3/4"
1 1/8"	1 5/64"	1 5/8"	1 3/4"
1 3/16"	1 9/64"	1 5/8"	1 3/4"
1 1/4"	1 13/64"	1 7/8"	2"
1 5/16"	1 17/64"	1 7/8"	2"
1 3/8"	1 21/64"	1 7/8"	2"
1 7/16"	1 25/64"	1 7/8"	2"

Fig. 2—Air motor tool for use in counterboring holes in crown sheets

speed steel and is made interchangeable with the socket to suit the different sizes of crown bolts shown in the table.

The air motor tool, details of which are shown in Figs.

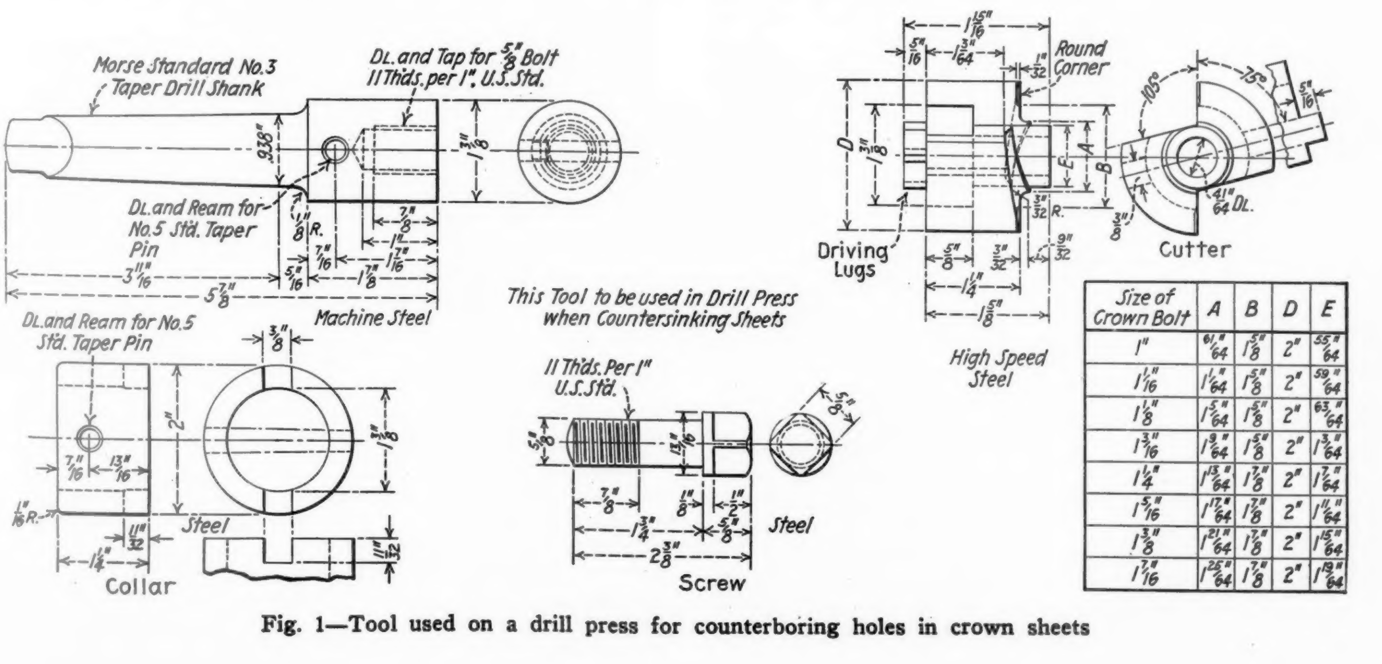


Size of Crown Bolt	F
1"	7/8"
1 1/16"	15/16"
1 1/8"	1"
1 3/16"	1 1/16"
1 1/4"	1 1/8"
1 5/16"	1 3/16"
1 3/8"	1 1/4"
1 7/16"	1 5/16"

Fig. 3—Pilot pin for the air motor tool

2 and 3, is also made with an interchangeable cutter, the dimensions of which are shown in the table in Fig. 2. The pilot pin screws into the end of the cutter as shown. Different diameters of pilot pins (see the table, Fig. 3) are provided to suit the sizes of the holes to be counterbored.

THE AVERAGE COST of railroad fuel coal in September was \$2.59 per ton, as compared with \$2.66 in September last year, according to the Interstate Commerce Commission's monthly statement of railroad fuel statistics, covering fuel for road locomotives in freight and passenger train service. The average cost of fuel oil was 2.97 cents a gallon, as compared with 3.18 cents in September last year. For the nine months ended with September the average cost of coal was \$2.61, and the average cost of oil was 2.92 cents. The total cost of coal and fuel oil for the nine months was \$236,072,343, as compared with \$240,523,945 in the corresponding period of last year.



Size of Crown Bolt	A	B	D	E
1"	61/64"	1 5/8"	2"	55/64"
1 1/16"	1 1/64"	1 5/8"	2"	59/64"
1 1/8"	1 5/64"	1 5/8"	2"	63/64"
1 3/16"	1 9/64"	1 5/8"	2"	1 3/64"
1 1/4"	1 13/64"	1 7/8"	2"	1 7/64"
1 5/16"	1 17/64"	1 7/8"	2"	1 11/64"
1 3/8"	1 21/64"	1 7/8"	2"	1 15/64"
1 7/16"	1 25/64"	1 7/8"	2"	1 19/64"

Fig. 1—Tool used on a drill press for counterboring holes in crown sheets

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

The little things that count

New York.

To the editor:

I have read with much interest the review of the book by E. R. Burton on Employee Representation in the *Railway Mechanical Engineer*. This article, in the October issue, page 586, is especially interesting at this time.

The newspapers recently carried on their front pages news items from Detroit, Mich., where the American Federation of Labor held its annual convention. The Federation advertises to the world that it is going to make a determined effort to do away with the "company unions."

I have been connected with various railroads in different capacities since 1911. Naturally in this time I have had experience with the standard unions, the company unions as in effect before the government operation of railroads during the war period, and the form of company unions in effect since 1922. At present, being in a supervisory capacity of a more or less minor nature with a railroad having employee representation, I am in a position to observe the workings of the plan. The more I see of it the more I am impressed with the statement of the author mentioned in your October article, page 587, where he is quoted as saying, "We cannot emphasize too strongly, however, that these products of employee representation—greater output, increased efficiency and improved morale—cannot be achieved unless * * *"

Under the plan of the road in question some points work under an agreement supposedly made between the representatives of the employees and representatives of the company. Without touching on the wage question, which is always debatable, I believe that the agreement is as good as is in effect on any railroad in the country today—if it is lived up to. In many of the more important items touching on working conditions the agreement is followed closely, but it is "the little things that count" and in many minor items there seem to be concerted efforts on the part of the department heads to evade the responsibilities of the agreement.

In many cases the employee representatives have been worn out in complaining of these violations until they feel that it is useless to try to handle such cases. As a direct result the most, or at least many of the employees have no confidence in the agreement, even though it is benefitting them in many cases. Minor instances that could and should be settled by department heads in a few minutes are dragged into days and weeks.

Many of the employees will not submit any grievance, either real or imaginary, to the representatives, feeling they are helpless. It would seem that such conditions would make a fertile field for an organizer of the regular labor union. Such a condition is just exactly what Mr. Burton warns against. The administration and managerial staff must be efficient, and obviously so. The fact that they are not is why company unions fall by the wayside to be succeeded by the old rip-snorting type of labor union. It seems strange that a company after spending considerable money in installing the employee representation plan will so neglect its investment after it is made as to permit conditions to arise such as those mentioned in this letter. And the pitiful part of the entire thing is that the higher officials who instituted the plans do not realize that their efforts are being defeated.

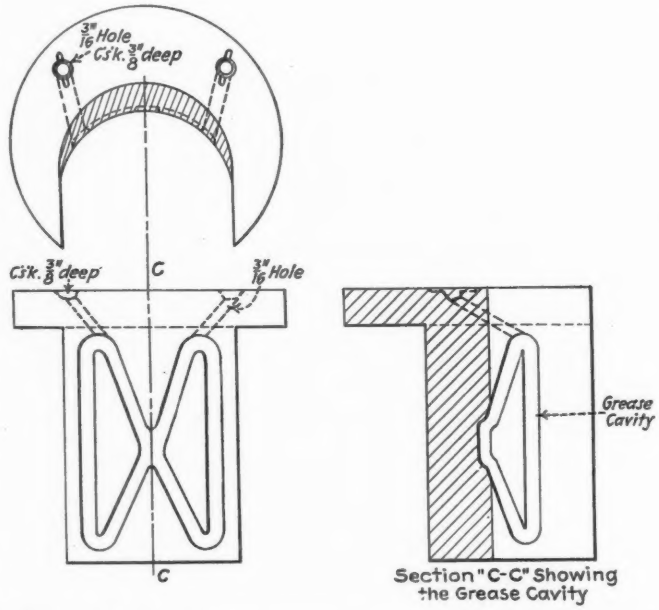
Observer.

Lubricating driving boxes to reduce lateral wear

Louisville, Ky.

To the editor:

I would like to make a suggestion relative to the lubrication of driving box brasses which I believe to be a considerable improvement over many of the methods used on locomotives at the present time. Referring to the sketch of the driving box, lubricant is drawn from the grease cavity in the brass through two 3/16-in. holes



Two 3/16-in. holes are drilled in the face of driving box to facilitate lubrication

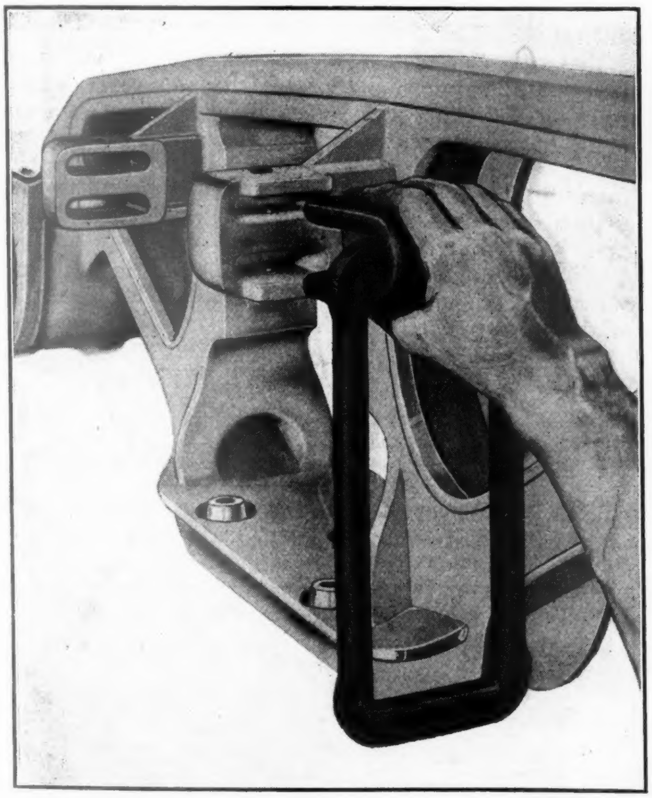
drilled through the face of the driving box. These holes are countersunk 3/8 in. deep, as shown in the sketch, and the liner is grooved at the holes to facilitate spreading the lubricant between the face of the liner and the hub.

I am of the opinion that this method of lubricating is of considerable help in reducing the lateral wear on the driving box and the hubs of the driving wheels. I would be glad to have the opinion of some of the readers of the *Railway Mechanical Engineer* on this method of hub lubrication.

William T. Speak.

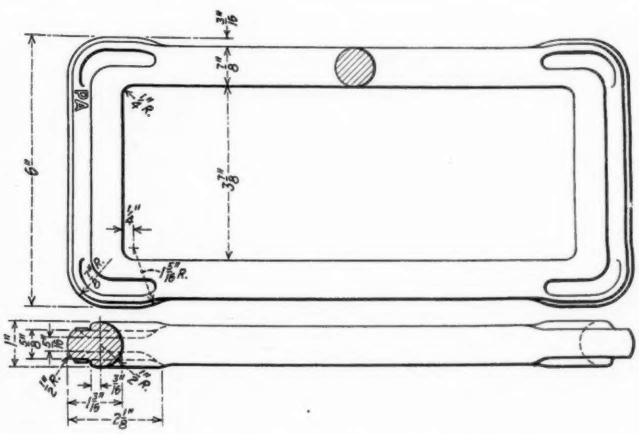
Loop type brake beam suspension

THE Schaefer Equipment Company, Oliver Building, Pittsburgh, Pa., has recently developed the new brake beam suspension shown in the illustration for application to freight and passenger car trucks and locomotive tender trucks. In designing this type suspension special consideration was given to the increasing use of trucks with cast steel side-frames in that the hanger should be of such design as to protect the side-frame brake hanger bracket against the destructive downward wear encountered where a horizontal brake pin is used. In the loop-type of hanger which this company is offering, instead of the old style open U-type or bottle-neck shaped hangers, the hanger is attached to the side-frame by means of a simple clevis which is fastened into the side-frame bracket with a vertical pin, thus entirely eliminating the horizontal pin fastening which is a desirable feature.



Close-up view of hanger and clevis support showing method of application to a cast steel truck side frame

The clevis is entered into the side-frame through two rectangular slots which are cored in the side-frame bracket. A clevis support of this character has the advantage of a great amount of contact surface in the side-frame bracket to receive the upward or downward thrusts caused by the reversal of the load on this member. It is also entirely independent of the side-frame so far as possible hanger wear is concerned and can be removed and turned upside down should the question of downward wear ever make this desirable. By utilizing a clevis of this construction the same amount of brake hanger contact is secured in the clevis at the side-frame as exists at the brake head.



Detail drawing of loop brake hanger showing principal dimensions

While the clevis fastening is normally made to receive a vertical pin, it can be riveted to the side-frame if this method of fastening is preferred.

The brake hanger shown is constructed so as to receive the maximum amount of material possible in the upper and lower cross-members which are in contact with the clevis and brake head, and the two vertical legs of the hanger are normally made of ⅞-in. round section. This hanger is made by a patented process, eliminating the weld commonly introduced in a loop hanger. This

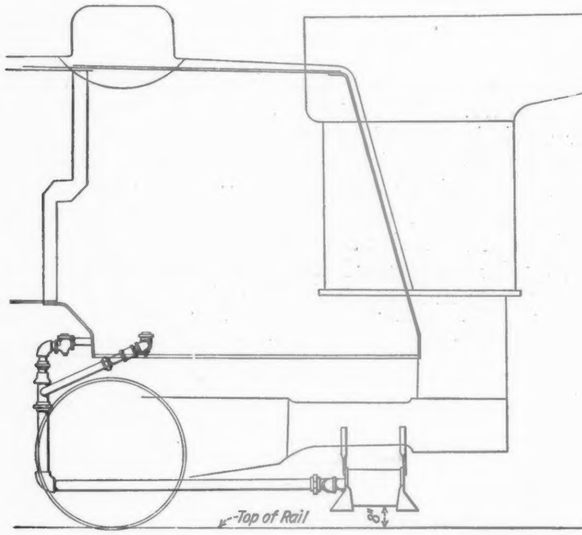
method facilitates the use of 0.40 to 0.50 carbon steel, with heat treatment to insure uniformity and maximum strength. The process is said also to permit the distribution of the metal in the cross-members to best advantage and it will be noted from the illustration that the I-beam section, which is of a sufficient depth to interlock the hanger at both top and bottom, is carried into the side members in a manner claimed to eliminate the weakness generally encountered in brake hangers which are made from a round bar bent into shape. The parallel cross members result in uniform contacts in both brake head and clevis member.

The clevis-connected hanger is entirely open at the point of contact with the side-frame thus enabling a man to inspect this point of contact at a glance. It also facilitates the permissible lateral motion of the brake beam without the introduction of bending strains, as the loop hangers may slide in the clevis instead of lifting off at one leg, thus localizing all the load at one point of suspension.

The weight of a loop hanger is said to be about 20 per cent less than that of a common U-type hanger of the same length and is nearly three times as strong in tension by actual tests.

Universal blow-off muffler

A LOCOMOTIVE blow-off muffler for all classes of power has been developed on the Kansas City Terminal railroad by W. E. New, master mechanic, and B. Yoakum, sheet metal foreman. It is designed to permit blowing off locomotive steam and water pressure at any time or place without danger to life or property and without the use of a blow-down box. Instead of discharging a high velocity jet of steam and hot water into the open air when necessary for any reason to reduce the concentration of boiler water on the road or to blow down the entire steam pressure at the terminal, the steam and water is discharged into the muffler and downward as a fine spray between the tracks. Steam and hot water are therefore not permitted to proceed from the side of the locomotive to interfere with the engineman's vision, or possibly to carry sediment-filled spray back over the coaches.



Application of the universal muffler blow-off

The method of applying this muffler is shown in the illustration. The construction is on the same principle as that of an automobile muffler as the blow-off steam enters at the center and passes through several baffle plates before being discharged downward at each end of the outer wrapper sheet. The two end castings are tapped at the center to receive the 2-in. blow-off pipe connections and is shaped at the bottom to receive and further break up or deflect the blow-off steam as it leaves at the outer wrapper sheet.

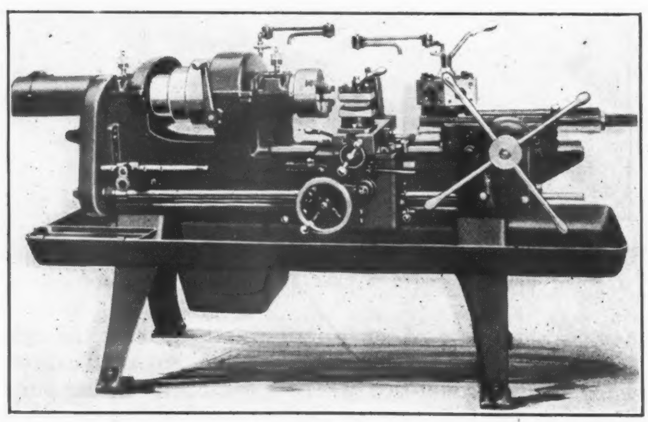
Arrangements have been made for the manufacture and sale of this muffler by the Locomotive Finished Material Company, Atchison, Kans.

Turret lathe with three types of head

THE Warner & Swasey Company, 5716 Carnegie avenue, Cleveland, Ohio, has recently placed on the market a new No. 4 Universal turret lathe which provides for the use of three different types of head; a six-speed all geared head; a six-speed cone head or a 12-speed all geared head. The bar capacity of the new machine is 1½ in. and the swing over the ways is 16 in.

Greater power to drive the spindle is delivered through the six-speed all geared head—it is said to be more than twice as much as through the cone head machine. Any one of six spindle speeds forward from 45 to 423 r.p.m. is available by moving convenient levers in the head. Two reverse speeds are provided. The gears run in oil and the shafts run in Timken roller bearings. Babbitt lined bearings are used for the spindle itself. This all geared head is well suited to individual motor drive.

A pedestal leg is provided for in which the motor can be mounted at the head end of the bed. This construction as nearly approaches a motor in the base machine as is possible for a turret lathe. Both ends of the motor cabinet are hinged, making the motor of easy

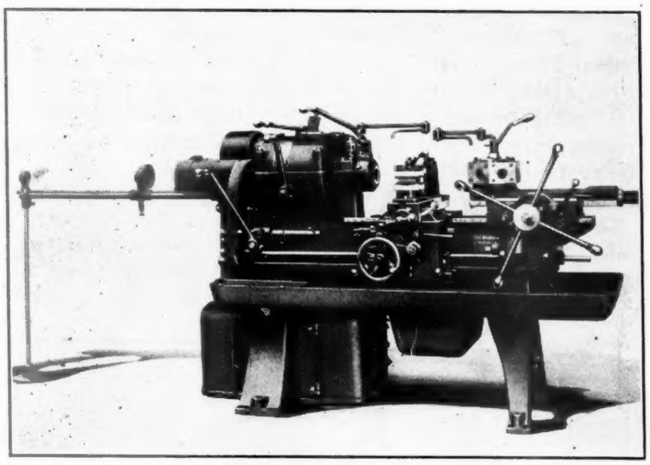

The No. 4 universal turret lathe with six-speed cone head with geared scroll chuck for chuck work

access. Provision is also made for mounting the motor on a vertical plate fastened at the head end of the machine. When arranged for motor driven the turret lathe is a production unit in itself and may be placed where convenient, regardless of line shaft conditions.

The cone type of geared friction head drive provides six spindle speeds, employing a three step cone and back gear. The back shaft is fixed in position with the gears always in engagement. The front spindle bearing is 3 in. in diameter and 4½ in. long. The rear bearing is 2½ in. in diameter and 3¾ in. long. By running both pulley countershafts forward at different speeds the number of obtainable spindle speeds with the cone type is raised to 12. This, however, does not provide a reverse movement of the spindle.

In former designs of Warner & Swasey hand screw machines an eccentric movement was provided for releasing the back shaft gears from contact with the spindle gears. This has been found unnecessary and the entire construction has been made more rigid through the elimination of this feature and through heavier back shaft bearing diameter and gear construction.

The 12-speed all geared head is the same design as that used on the No. 4 Universal turret lathe described in the *Railway Mechanical Engineer* for February, 1925, page 126. This type of head provides 12 spindle speeds running from 30 to 760 r.p.m. The speed changes are obtained through slide gears. The gears run in oil and the friction clutch is easily adjusted. This type of head is recommended for work requiring extreme power, or for work requiring a great variety of spindle speeds. Heavy cuts may be taken and both "multiple cuts" and "combined cuts" may be operated at the same time on work ranging up to the capacity of the machine.



The Warner & Swasey No. 4, six-speed all geared head universal turret lathe with automatic chuck for bar work

The automatic chuck and bar feed are operated by the long lever in front of the head. This grips or releases the work instantly. A pivoted operating yoke with rollers engaging the wedge is an improvement in the automatic chuck mechanism which substantially reduces the effort required to operate the chuck. A stepped wedge on the spindle, operating fingers provided with rollers, automatically adjusts the collet for slightly varying diameters.

The distinctive feature of the No. 4 Universal turret lathe, the universal cross slide carriage, is retained in the new design which provides a strengthened cross slide unit with power longitudinal feeds either left or right, and power cross feeds in either direction, as standard. The square turret provides four cutter positions in addition to the one in the rear tool post. These cutters may be operated simultaneously with the tools on the hexagon turret. Four independent, adjustable stops carried on a stop roll throw out the longitudinal feed. The feeds are all available from the apron of the carriage, greatly facilitating changes of feeds. The feeds may be reversed. In the direction of feed, the cross slide carriage is independent of the turret. A large graduated dial is fitted to the cross slide with adjustable indicators for accurately gaging the depth of cut. The square turret is quickly indexed without lifting it from its seat. Accurate alinement and adjustment of the square turret are assured by hardened and ground tapered wearing surfaces. This patented feature makes possible the accurate duplication of work.

The turret slide and saddle unit is of a type common to Warner & Swasey machines. A supplementary taper base and taper gibs provide for vertical and horizontal adjustments to assure alinement for wear. Six power feeds are obtained through a gear box mounted in the front of the saddle. Independent adjustable stops are provided for each turret face which may be set to throw out the power feed at any point desired. These feeds are independent of the cross slide carriage feeds.

The No. 4 Universal turret lathe is offered either as a bar machine or with a standard bar or chucking equipment. The bar equipment will handle a great majority of the work within the cutting range of the machine and consists of the following tools: Flanged tool holder, single cutter turner, multiple cutter turner, end facing tool, center drilling tool and self opening die head. For light work where piloting is unnecessary, or for center piloting on quantity work, the following plain set of chucking tools is offered: Multiple cutter head, flanged boring cutter, multiple turning head, drill holder, vertical slide tool and floating tool holder. A set of chucking equipment with overhead pilots is also offered where additional rigidity is necessary. This set differs from the plain set of chucking equipment in only two tool stations. An overhead piloted multiple turning head is substituted for one multiple cutter head, and an overhead pilot bar is added to the multiple turning head which already carries an ear for this purpose.

The machine may be equipped with a taper attachment which will turn tapers up to three inches to the foot, in lengths of six inches. The operation of the square and hexagon turrets is not affected by the installation of the taper attachment. A new design of screw chasing attachment cuts threads from 4 to 32 pitch, operating by means of a leader and follower. A micrometer screw attached to the cross slide provides a fine adjustment for the depth of cut.

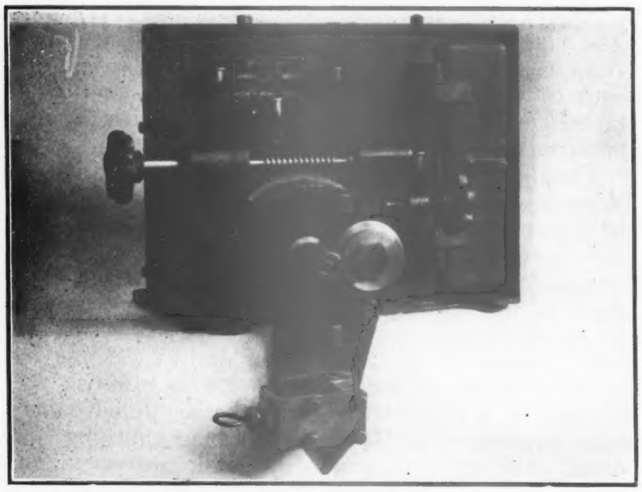
GRINDERS.—A new publication on Cincinnati plunge cut grinders has been issued by Cincinnati Grinders, Inc., Cincinnati, Ohio.

GASOLINE RAIL CARS.—The Edwards Model 20 gasoline rail car is described in the 20-page illustrated catalogue of the Edwards Railway Motor Car Company, Sanford, N. C. This car is designed for branch line passenger, mail and express service where traffic is fairly heavy, and is so constructed that an additional power truck for handling trailers, etc., could be put under the rear of the car should the necessity for additional power arise.

TURRET LATHE PRACTICE.—The Warner & Swasey Company, Cleveland, Ohio, shows in a four-page folder how the multiple cutter turner was used for turning a number of diameters on three typical bar jobs. This multiple cutter turner consists of three parts—the body, the top plate and the roll carrier. The body serves as a support for mounting the top plate and one or two roll carriers in different positions. The top plate has screws for holding cutters in different positions, and spacer bushings are provided between it and the body to prevent springing.

Westinghouse automatic arc welder

THE Auto-Arc is a machine for automatically feeding a continuous welding wire, used in metallic electrode welding, to the work at any speed up to three feet per minute, which is necessary to maintain a constant arc length and a constant arc voltage.



Westinghouse Auto-Arc for welding automatically

This machine, which is built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., strikes the arc automatically and, if necessary, will exert a pull of approximately 200 lb. in order to prevent fusion of the electrode wire to the work.

This device relieves the operator of the tiresome and exacting hand labor of maintaining the arc and feeding the welding wire, and because the electrical conditions of the arc remain practically constant, it is possible to secure a better weld and to deposit metal faster than can be done by hand welding.

The arc length can be adjusted so that the arc can be maintained at an average value of from 15 to 20 volts and will remain almost constant at any given voltage. The 1/4 hp. feed motor and the electro-magnets do not obtain power from the arc circuit, and are therefore selected large enough to feed any size wire up to 3/8 in.

This equipment can be used to advantage on work requiring the welding of long continuous seams, and also for some repair applications, such as building up worn crossheads, and crosshead guides and valve guides for locomotives. It is also applied in building up worn flanges for yard locomotives.

The machine is said to provide better fusion, due to the use of a higher current; ease of operation, permitting an inexperienced operator to handle it; uniformity of metal deposit, and the reduction in costs due to the ability to use wire in continuous lengths without the necessity of straightening and cutting. Other features of this equipment are dirt-proof housing and ease of accessibility to the parts.

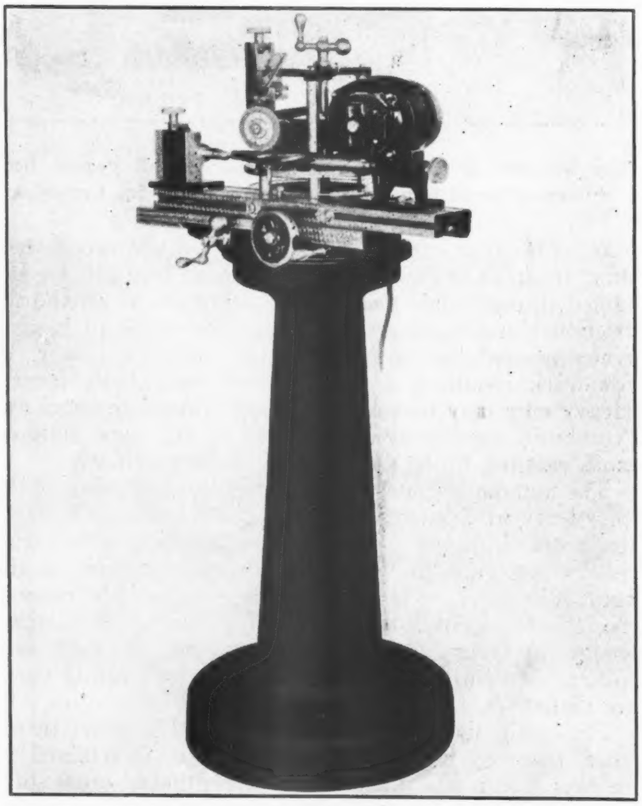
Circular relief grinder

A NEW method for grinding the relief on reamers, taps, milling cutters, etc., is accomplished by a machine developed by the Cleveland Tool Engineering Company, Main and West 25th street, Cleveland, Ohio.

This machine was designed primarily to grind in one operation taper taps, boiler, bridge and ship reamers, adjustable reamers, milling cutters and other tools that require clearance along the sides.

The face of the grinding wheel is dressed concavely exactly to the same curve as the tool to be ground. This is done with a diamond located above the grinding wheel. The tool to be ground is offset from the center of the curve of the wheel by a transverse movement of the table and the tool is ground to the cutting edge in one operation. This grinding produces a convex surface adjoining the cutting edge, the circular relief being ground to the same curve as has been provided on the face of the grinding wheel. The amount of clearance is determined by the distance the tool is moved in or out against the curved face of the grinding wheel. The convex contour of the relief leaves all the metal possible to support the cutting edge. This is said to eliminate chatter and to reduce the wear of the tool.

The longitudinal movement of the table is 15 in. and the distance between the centers is 18 in. The swing is 5 in. The down feed of the cutting wheel, with graduations of a thousandth of an inch, is controlled by a handle on the head. The head itself swings, with graduations in degrees for spiral work. The feed screw and the cross feed are graduated in thousandths of an inch.



A grinder for reamers and milling cutters in which the wheel is dressed to conform to the contour of the work

The machine is belt driven by a ¼-hp. motor either alternating or direct current, operating at 1,725 r.p.m. The motor is mounted on the head. The diameter of the wheel is 4 in. The spindle is of alloy steel running in dust-proof ball bearings. The overall height is 4 ft. 5 in.

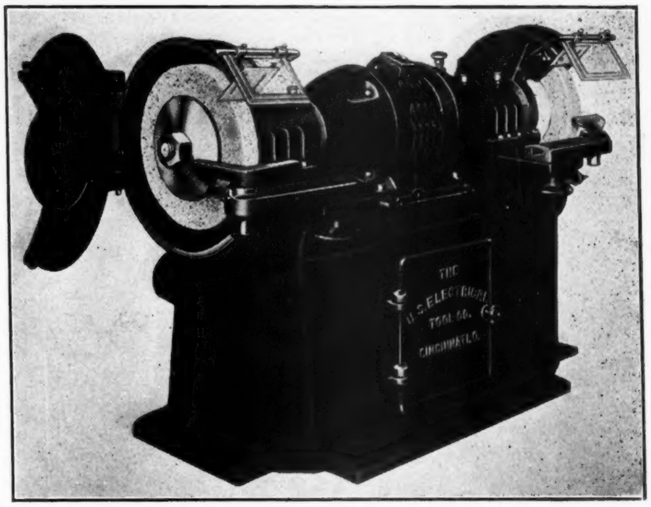
Heavy duty four-ball-bearing grinder

THE grinder shown in the illustration is one of several new tools placed on the market recently by the United States Electrical Tool Company, Cincinnati, O.

This new heavy duty machine is built in six sizes ranging from 18 in. by 3 in. to 30 in. by 5 in. and driven by motors from 5 hp. to 15 hp., inclusive. They are designed to withstand continuous heavy production service and are constructed with a view to the elimination of vibration.

The grinding wheel spindle is of nickel steel made in one piece, provided with a positive shaft locking device for holding the spindle while renewing grinding wheels, and mounted in four S.K.F. heavy duty ball bearings, enclosed in dust-proof boxes. The inner wheel flange is keyed to the spindle. The machines are equipped with motors of either General Electric, United States, or Westinghouse construction for either direct or alternating current. Direct current motors are for 110, 220, 440 and 550 volts, while a.c. motors are for 220, 440 and 550 volts, two or three phase, and the commonly used frequencies. The wide selection of motors makes the machine adaptable to almost any shop conditions.

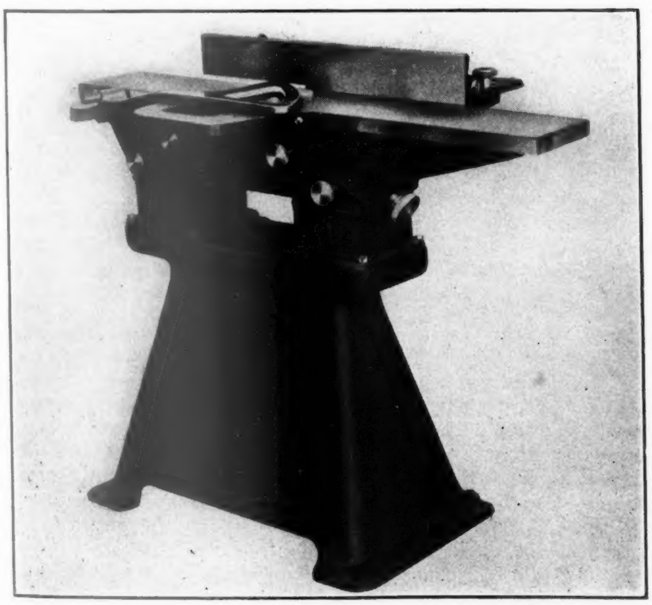
Grinders equipped with a.c. motors are equipped with remote control having overload relay and no-voltage release, assuring motor protection. Direct current motors have manually operated starters and fused switches. The wheel guards are equipped with an exhaust connection, hinged doors, spark breakers and adjustable unbreakable glass eye shields. The whole machine is mounted on a heavy cast-iron base with cut out corners for convenience.



U. S. heavy-duty constant speed grinder, showing the new inset base

Oliver hand planer and jointer

THE Oliver Machinery Company, Grand Rapids, Mich., in carrying out its development of the direct motor arbor machines has recently placed on the market a new motor arbor six-inch jointer known as No. 144. Although this is rated as a six-inch machine, it is built for production work and while designed in a manner which adapts it for use as a bench machine it is not in any sense a portable machine. The head of the machine is built as a unit embodying the tables, cutter cylinder and motor—the whole, if not used as a bench machine, being mounted on a rigid cast iron floor column. The bed of the machine is cast solid with columns and ball bearing housings and carries the inclined ways which support the tables on 60-deg. dovetail bearings. There are two tables each 6½ in. wide; the front or operating table is 24½ in. long and the back table 15½ in. long. Each table is independently adjustable toward and away from the cylinder by means of knurled hand wheels and screw. Locking screws are provided at the front of the tables.



The Oliver hand planer and jointer may be used as a bench or a floor type machine

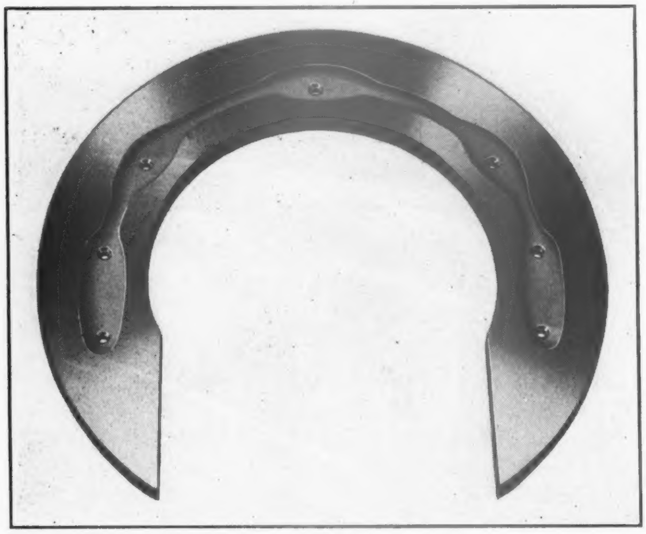
The cylinder is of forged crucible steel and of patented elliptical design for clearance of shavings and smoothness of cut. The cylinder may be equipped with either two or three knives. The cylinder has a 3⅛-in. cutting diameter and is designed to work at a speed of 4,500 r.p.m. for the two-knife and 3,600 r.p.m. for the three-knife cylinder. The machine is equipped with an aluminum automatic knife guard which is designed to cover that part of the knives not actually cutting.

The cutting cylinder is mounted in double row self-alining ball bearings. Grease cup lubrication to each bearing is provided. The fence is 24 in. long and 3½ in. wide and may be locked at any angle from 90 to 45 deg.

A rabbeting attachment is furnished with each machine which may easily be removed at any time. The machine may be driven in one of three distinct types of motor drive: Direct motor on cylinder shaft; direct coupled motor drive and belted motor drive. The motor equipment consists of a ½ to 1 hp. motor, depending on the type of work which it may be used for in the wood mill.

Driving box self-lubricating lateral plate

IN an effort to solve the problem of lateral wear on driving boxes, the More-Jones Brass & Metal Company, St. Louis, Mo., has developed a self-lubricating bronze lateral plate for driving boxes. It is cast close to the dimensions required which, it is claimed, allows the lateral plate to be applied at less than half the expense required in the present method of pouring the plate on the box. This practice usually requires an excess of metal, which is machined off. The renewal of the self-lubricating plate requires only the nicking of the



The lubrication is fed to the lateral plate from a grease groove of the driving box bearing

welds and the wedging off of the plate, permitting the salvage of the material in a single piece.

The lubricant is fed to the face of the lateral plate from the first grease groove of the driving box bearing and therefore is automatically lubricated.

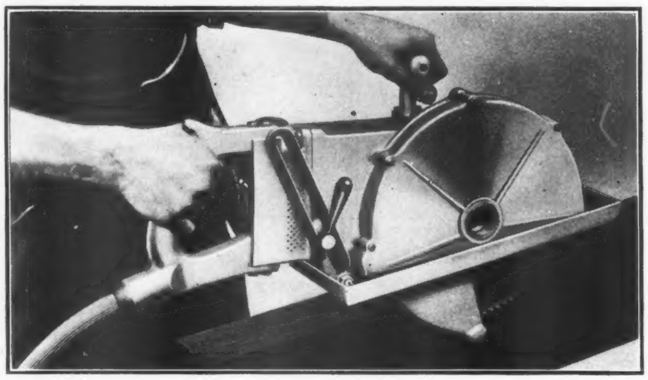
Portable electric hand saw

A PORTABLE electric hand saw, known as the Alta saw and equipped with a 9-in. blade which cuts a maximum of 3⅛-in. material, has been placed on the market by the Wappat Gear Works, Pittsburgh, Pa.

It is claimed that one man with this saw can, in a given time, cut as much lumber as ten men with ordinary hand saws. Heavier material that is ordinarily carried to a table saw, can be cut off or ripped with this portable saw.

The saw blade is completely enclosed by a telescopic guard which automatically opens only when the saw is pushed into the material. It automatically closes again as the cut is completed. This guard affords a maximum safeguard against accident and protects the blade from damage.

The wide carrying shoe supports the tool and prevents tipping, thereby limiting the operator's effort to mere guiding. A blast of air from the motor ventilating fan is directed to the front of the saw to blow the sawdust away. This keeps the path of the saw clear and enables the operator to cut accurately to a line. The



A portable electric hand saw provided with an automatic guard

shoe is adjustable, making it possible to set the saw for any depth of cut, such as is required when cutting out sections of flooring, etc.

The ¾-hp. motor is of the universal type which operates on either alternating or direct current. Timken tapered roller bearings and a quiet running worm gear drive insure maximum power at the saw blade with minimum wear and without vibration.

WELDING HEAD AND CONTROL.—The G-E automatic welding head and control is described and illustrated in a four-page folder issued by the General Electric Company, Schenectady, N. Y.

MILLING CUTTERS.—The Goddard & Goddard Company, Detroit, Mich., has recently issued catalogue "C" containing complete information on the various types of milling cutters manufactured by that company. In addition to the usual information concerning specifications and prices of the various styles of cutters, this new catalogue presents valuable instructions concerning the proper grinding of the different types of milling cutters.

BABBITT METAL DATA.—An outline of the chief considerations in the design of a bearing and the proper method of casting the metal and fitting so as to secure a properly fitted bearing having an efficient metal structure, is given in a 20-page brochure which has been prepared by the Hoyt Metal Company, Boatmen's Bank building, St. Louis, Mo. The table in this brochure gives the melting point, liquidation, specific gravity, proper pouring temperatures, etc., of various brands of Hoyt babbitt metal.

METAL CUTTING CHART.—Under the title "The Right Saw for the Purpose," the Racine Tool & Machine Company, Racine, Wis., has issued a four-page circular with enclosed chart designed to promote greater efficiency in the use of high speed metal cutting saws. The absolute necessity of selecting the right saw for the purpose is strongly emphasized and by means of the chart this company places at the disposal of shop men, many years of experience in the design, manufacture and use of metal cutting saws. Full instructions are given in the chart regarding the proper speed of the machine, pitch, gage, width and length of blade for various sizes of all sorts of material from aluminum, brass, copper, Monel metal and rubber to steel tubing and structural steel shapes. The kind of cutting or cooling compound, when any is necessary, is also indicated.

News of the Month

Wage increases

The Union Pacific has granted wage increases of approximately two cents an hour to 12,000 shop employees and 2,000 miscellaneous workers, including mostly trackmen, linemen, mechanics and helpers.

The Chicago Great Western has granted wage increases of two cents an hour to shopmen.

The Southern Pacific has granted shop mechanics, helpers, apprentices and coach cleaners increases in wages amounting to one cent an hour. The new rate for mechanics in the metal crafts and passenger car departments is 76 cents an hour; for car inspectors and freight car builders 67 cents an hour; for helper 48 cents to 51 cents an hour; for coach cleaners 38 cents to 41 cents an hour; and for apprentices 28 cents to 53 cents an hour.

Premium payments abolished in C. N. R. shops at instance of co-operative committee

Abolition of the bonus or premium system in all shops of the Canadian National with the payment from December 8 of an increase of two cents per hour to employees thus affected, was announced in a statement made public on December 5 by S. J. Hungerford, vice-president in charge of operation.

The statement follows:

"Following the amalgamation of the various railways now constituting the Canadian National Railways System, there was found, as would naturally be expected, many variations in practice and method. Obviously, uniformity was both necessary and desirable under the new conditions and the management has been progressively studying each of the questions involved with a view to selecting that method which was considered the best available for the particular purpose, or, as an alternative, the development of an entirely new one for adoption throughout the system.

"Among the many variations in practice, it was found that at some of the older repair shops, a so-called premium payment plan had been in vogue, to a greater or less extent for many years, whereby those working under the plan were paid an amount in addition to the regular hourly wage, for output in excess of an established standard, whereas in the shops on the greater part of the system, the usual hourly wage system only was in effect.

"At the beginning of 1925, a plan of co-operation between the federated shop trades and the management of the Canadian National Railways was inaugurated which had, among other objectives, the more efficient operation of shops; stabilization of employment as far as practicable; and the study and development of those matters related to shop operations of mutual benefit to employer and employees. To this end, committees consisting of a substantially equal number of foremen or other local supervisory officers and representative workmen selected by the employees themselves in the respective shops, have since held meetings at regular intervals, at which all suggestions relating to the work and surrounding circumstances excepting wages and conditions related thereto, have been studied and discussed, with the result that substantial improvements of mutual interest to both parties to the plan have been secured. In addition to the various local mixed committees, a similar committee has been established on each general manager's region and also one for the entire system, to deal with questions of a general rather than a local character.

"Among the various questions considered by the system committee is the premium plan of payment in comparison with the fixed hourly wage basis and as a result of these studies, the conclusion has been reached that while the premium plan is attractive theoretically and operates satisfactorily in factories where large numbers of new articles of similar design are being produced, it is very difficult to administer in railway shops where by far the greater proportion of the work consists of refitting worn parts rather than manufacturing new ones, and under these conditions, it is not as generally satisfactory as the hourly wage basis and has certain inherent objectionable features in-so-far as railway repair work is concerned.

"The operation of the co-operative plan has now reached such a stage that the bonus system has ceased to be either advantageous or attractive. Therefore the management regards it as eminently just that the premium system should be abandoned and an appropriate bonus, in addition to the hourly rate, be paid, as a recognition of their co-operative effort, to all employees of the Canadian National Railways in the mechanical department covered by Wage Agreement No. 6, between the Railway Association of Canada and the federated shop trades.

"Therefore, in pursuance of this decision, the bonus or premium system is abolished in all of the shops of the Canada National Railways, and effective December 8, 1926, all of the employees referred to in the above paragraph will receive an increase over and above their present hourly rate of two cents per hour, in lieu of the premium previously disbursed.

"Under the new method, the company will not pay the workmen, in the aggregate, any more than has been paid hitherto, and in addition will secure certain other economies. Having regard to all of the factors involved, it is confidently believed that this change in practice will, on the whole, be of benefit to both the railway and the employees concerned."

Court news

Defective car statute held not applicable to repairers.—In an action for injuries to a repairman while repairing a defective box car, the Circuit Court of Appeals, Sixth Circuit, holds that Ohio Gen. Code, Section 9017, making railroads liable for injuries to employees from defective cars, does not apply to injuries to repairmen while repairing such cars. Section 6243 of the code applies to defects in permanent fixtures, and not to cars, nor to defects which the workmen are engaged to repair.—Noftz v. B. & O., 13 F. (2d) 389.

Regulation of locomotive equipment of interstate railroad within exclusive jurisdiction of Congress

Three cases came before the Supreme Court of the United States, one on appeal from the federal district court for northern Georgia, Napier v. Atlantic Coast Line, 2 Fed. (2d) 891, and two on writ of error to the Supreme Court of Wisconsin, Chicago & North Western v. Railroad Commission and Chicago, Milwaukee & St. Paul v. Railroad Commission, known as the Cab Curtain Cases, 188 Wis., 232, involving a determination of the scope and effect of the federal boiler inspection act. The main question in all three cases was whether the act has occupied the field of regulating locomotive equipment used on an interstate railroad so as to preclude state legislation. The Georgia case involved a Georgia statute prescribing an automatic door to the firebox, the enforcement of which the district court enjoined. The Wisconsin cases involved a Wisconsin statute prescribing a cab curtain, where the state Supreme Court denied the injunction sought by the railroads. In Georgia the details of the device

were prescribed by the legislature. In Wisconsin the specifications were prescribed by an order issued by the state Railroad Commission.

The Supreme Court has affirmed the decree of the Georgia federal district court and reversed the state court's judgment in the Wisconsin cases.

The court in its opinion says that: "Prior to the passage of the boiler inspection act, Congress had, by the safety appliance act and several amendments, itself made requirements concerning the equipment of locomotives used in interstate commerce. It had required a power driving-wheel brake, automatic couplers, grabirons, drawbars, ash pans, and other things. Congress first conferred upon the Interstate Commerce Commission power in respect to locomotive equipment in 1911. The original act applied only to the boiler." The provisions of that act were extended in 1915 to include the entire locomotive and tender and all parts and appurtenances thereof. In 1924, section 2 of the original act was amended, making it unlawful to use any locomotive unless in proper condition and safe to operate and unless inspected from time to time in accordance with the provisions of the act and able to withstand the tests prescribed in the rules and regulations therein provided for. "Other sections," the opinion says, "confer upon inspectors and the commission power to prescribe requirements and establish rules to secure compliance with the provisions of section 2. From time to time since the passage of the original act, the commission has required that locomotives used in interstate commerce be equipped with various devices. But it has made no order requiring either a particular type of fire-box door or a cab curtain. Nor has Congress legislated specifically in respect to either device."

The automatic fire-door, the court says, conserves the health and eyesight of the fireman, and protects the safety of the employees, and incidentally of the train, in the event of an explosion in the fire-box, and that of travelers at grade crossings by preventing the glare from the open door blinding the fireman for a time and so possibly interfering with his duty as a lookout. The purpose of the cab curtain is to protect engineers and firemen from the weather during the winter season.

"Does the legislation of Congress manifest the intention to occupy the entire field of regulating locomotive equipment? It did not do so by the safety appliance act nor by the original boiler inspection act. But the power delegated to the commission by the boiler inspection act as amended is a general one. It extends to the design, the construction and the material of every part of the locomotive and tender and of all appurtenances of motive equipment.

"The question whether the boiler inspection act confers upon the Interstate Commerce Commission power to specify the sort of equipment to be used on locomotives was left open in Vandalia v. P. S. C., 242 U. S. 255. We think that power was conferred. The duty of the commission is not merely to inspect. It is, also, to prescribe the rules and regulations by which fitness for service shall be determined. Unless these rules and regulations are complied with, the engine is not 'in proper condition' for operation. Thus the commission sets the standard. By setting the standard it imposes requirements. The power to require specific devices was exercised before the amendment of 1915, and has been extensively exercised since.

"The fact that the commission has not seen fit to exercise its authority to the full extent conferred has no bearing upon the construction of the act delegating the power. We hold that state legislation is precluded, because the boiler inspection act, as we construe it, was intended to occupy the field. The broad scope of the authority conferred upon the commission leads to that conclusion. Because the standard set by the commission must prevail, requirements by the states are precluded, however commendable or however different their purpose. . . . If the protection now afforded by the commission's rules is deemed inadequate, application for relief must be made to it. The commission's power is ample. Obviously, the rules to be prescribed for this purpose need not be uniform throughout the United States; or at all seasons; or for all classes of service."—Napier v. A. C. L.; C. & N. W. v. Railroad Commission; Chicago M. & St. P. v. Railroad Commission. Decided November 29, 1926. Opinion by Mr. Justice Brandeis.

Meetings and Conventions

Division VI, Purchases and Stores, American Railway Association, will hold its 1927 meeting at Chicago in May or June. There will be no exhibits of railway supply manufacturers.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

Air-Brake Association.—T. L. Burton, acting secretary, 165 Broadway, N. Y. Next meeting May 24, 25, 26 and 27, Mayflower Hotel, Washington, D. C.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Association Division V.—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 7, 8 and 9, Hotel Windsor, Montreal.

Division V—Equipment Painting Section.—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey St., New York.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention Chicago, Sept. 7-9, 1927.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

American Society for Steel Treatment.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Birmingham Car Foremen and Car Inspectors' Association.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. Building.

Canadian Railway Club.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill. Next meeting January 10. Entire evening will be devoted to a discussion of the new A. R. A. rules.

Car Foremen's Association of St. Louis.—F. D. Wiegmar, 720 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

Car Foremen's Club of Los Angeles.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August, Hotel Statler, Buffalo, N. Y. Next meeting, January 13, at 2 p. m. Election of officers. Annual dinner in evening.

Chief Interchange Car Inspectors' and Car Foremen's Association.—A. S. Sternberg, Belt railway, Clearing Station, Chicago. Annual convention, Chicago, September, 1927.

Cincinnati Railway Club.—D. R. Boyd, 811 Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

Cleveland Railway Club.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Annual meeting January 10.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Lafayette, Buffalo, N. Y., August 16-18, 1927.

International Railway Fuel Association.—L. G. Plant Railway Exchange, 80 E. Jackson boulevard, Chicago. Annual convention May 10 to 13, 1927, Chicago.

International Railway General Foremen's Association.—William Hall, 1051 W. Wabash Ave., Winona, Minn. Annual convention Chicago, September 6-9, 1927.

Louisiana Car Department Association.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting Chicago, May, 1927.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting January 11. Paper on motor transportation will be read by H. F. Fritch, general traffic manager of the Boston & Maine.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Club of Greenville.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August. Next meeting January 27. F. G. Snyder, general manager of the B. & L. E. will present a paper at this meeting.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November.

Southeastern Carmen's Interchange Association.—C. Kimball, Inman shops, Southern, Atlanta, Ga.

Texas Car Foremen's Association.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month, Terminal Hotel Bldg., Fort Worth, Tex.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September, 1927.

Western Railway Club.—Bruce V. Crandall, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

A. C. Schleifer has been appointed mechanical engineer of the E. A. Lundy Company, Pittsburgh, Pa.

The American Steel Foundries Company, Chicago, has purchased the Verona Steel Castings Company, Verona, Pa.

Henry S. LaBarge has been appointed manager of railway and marine sales of the Glidden Company, Cleveland, Ohio.

Henry N. Winner, general manager of the Garlock Packing Company, Palmyra, N. Y., died on November 12 at Philadelphia, Pa.

Joseph Beaumont has resigned as vice-president and director of the Regan Safety Devices Company to engage in other business.

The Vapor Car Heating Company, Inc., has removed its Boston, Mass., office to the Little building, 80 Boylston street.

The Southern Wheel Company has purchased the car wheel plant at Hammond, Ind., of the New York Car Wheel Company of Indiana.

A. N. Martin, formerly in charge of the purchasing department of the Pyle-National Company, with headquarters at Chicago, has been elected vice-president, with headquarters at New York.

The Link-Belt Company, Chicago, has opened a sales and service branch at 152 Temple street, New Haven, Conn., in charge of R. H. Hagner, formerly of the company's Philadelphia office.

G. M. Eaton, formerly chief mechanical engineer of the Westinghouse Electric & Manufacturing Company, has joined the Molybdenum Corporation of America, in a sales engineering capacity.

The Griffin Wheel Company, Chicago, has purchased the Standard Car Wheel Company, Cleveland, Ohio, and the Saint Bernard Manufacturing Company, Cincinnati, Ohio, which it will operate as branch plants.

Joseph T. Ryerson & Son, Inc., Chicago, has purchased the warehouse division and property of the Bourne-Fuller Company, Cleveland, Ohio, and will add to the facilities and increase the size and range of stock carried.

J. B. Weigel, formerly general interlocking supervisor of the Seaboard Air Line, has been appointed a representative in the railroad materials division of the Ohio Brass Company, with headquarters at Mansfield, Ohio.

M. J. A. Bertin, managing director of the Sociéte Anonyme des Huiles Galena, Paris, France, has been elected president of the parent company, Galena Signal Oil Company (Pennsylvania), with headquarters at New York, to succeed L. J. Drake, resigned.

Frank K. Metzger, manager of sales of the Standard Steel Works Company at Philadelphia, Pa., has been elected a vice-president to succeed Richard Sanderson, resigned. R. Nevin Watt succeeds Mr. Metzger as manager of sales, with headquarters at Philadelphia.

The Ohio Brass Company, Mansfield, Ohio, has established new quarters for its San Francisco, Cal., branch office in the Matson building, 215 Market street, and new quarters for its Los Angeles branch office in the Subway Terminal building, 417 S. Hill street.

A. T. Herr has been appointed sales representative of the American Locomotive Company at Denver, Colo., with office in the United States Bank building, and J. W. Harty has been appointed sales representative at Detroit, Mich., with office in the General Motors Corporation building.

J. T. Stephenson, railway supply manufacturer's agent, with office in the Munsey building, Washington, D. C., has been appointed railway sales representative in the territory embracing Washington, D. C., Baltimore, Md., and vicinity, of the Warren Tool & Forge Company, Warren, Ohio.

W. S. Koithan and R. W. Pryor, Jr., have been placed in charge of the Philadelphia office of the Buffalo Forge Company in the Land Title building. Mr. Koithan and Mr. Pryor, who for many years have been joint managers of the New York office, will continue to manage the New York district.

Arthur C. Pletz has been appointed sales manager of the miscellaneous machinery department of the Niles Tool Works Company division of the Niles-Bement-Pond Company, with headquarters at Hamilton, Ohio. L. A. Quinn has been appointed acting manager of the Birmingham office of the Niles Tool Works, succeeding N. C. Walpole, deceased.

Robert S. Glenn, manager of the New York store of the Cleveland Twist Drill Company, has been appointed assistant to the president, with headquarters at Cleveland, Ohio. Oliver B. Hansen, representative in the southeastern territory, with headquarters at Atlanta, Ga., succeeds Mr. Glenn at New York, and Irving P. Farnum succeeds Mr. Hansen at Atlanta.

The Western Machine Tool Works, Holland, Mich., has bought the entire assets of the John Steptoe Shaper business, Cincinnati, Ohio. The Steptoe shapers have been built since 1845, and the new owners will continue the manufacturing of the complete line of Steptoe shapers which are built from 14-in. to 24-in. sizes.

J. H. Ridge has been appointed branch manager of the Pittsburgh branch of the Timken Roller Bearing Service & Sales Company, with headquarters at Pittsburgh, Pa. G. G. Weston has been appointed branch manager of the Omaha branch, with headquarters at Omaha, Neb. Paul Ackerman has been appointed engineer of the service department, at Canton, Ohio.

M. A. Blessing, assistant manager of sales of the Jones & Laughlin Steel Corporation, has been appointed district manager of sales, with headquarters at Chicago; Vernon C. Ward has been appointed manager of sales of the steel construction department, with headquarters at Pittsburgh, Pa.; G. H. Danforth has been appointed contracting engineer of the Fabricating division, and C. I. Boardman has been appointed contracting engineer of the Junior Beam division.

Archibald H. Ehle, general sales manager of the Baldwin Locomotive Works, Philadelphia, Pa., has been elected vice-president in charge of domestic sales, with headquarters at the same place, to succeed Grafton Greenough, deceased. Stewart McNaughton, sales manager of the central zone, with headquarters at Philadelphia, has been elected manager of domestic sales, succeeding to the former duties of Mr. Ehle. Mr. McNaughton will continue to have his headquarters at Philadelphia.

J. Dalrymple Rogers has resigned as London manager of the Baldwin Locomotive Works. Prior to the war Mr. Rogers was associated with several American railways and during the war was on the staff of the Director General of Military Railways. Since then he has represented the Baldwin Locomotive Works in South Africa, India and other parts of the British Empire. Ashton Dorr, formerly assistant manager of the Paris office succeeds Mr. Rogers as manager of the London office.

At a recent meeting of the board of directors of Pratt & Lambert, Inc., Buffalo, N. Y., the following officers were elected: J. N. Welter, of Chicago, chairman of the board; A. D. Graves, Buffalo, president; H. E. Webster, Buffalo, senior vice-president; J. P. Gowing, Chicago, vice-president; W. P. Werheim, Buffalo, treasurer; R. W. Lindsay, Buffalo, assistant treasurer. Both J. B. Bouck, Jr., New York, and F. W. Robinson, Buffalo, each elected vice-president in 1924, continue in that capacity. H. E. Webster and W. P. Werheim also continue as secretary and assistant secretary, respectively.

John Rainey McGinley of Pittsburgh, Pa., a former associate of the late George Westinghouse, with whom he organized the Westinghouse Electric & Manufacturing Company, died on November 29 in New York City at the age of 75. Mr. McGinley served with the Philadelphia Company of Pittsburgh as vice-president and general manager for many years. He was a director of the Chicago Pneumatic Tool Company, director of the Duff Manufacturing Company, chairman of the board of the Pittsburgh Screw & Bolt Company and a director of Dwight P. Robinson & Co., Inc., and of the Gary Screw & Bolt Company.

Trade Publications

STEEL PLATE BLOWER.—The American Blower Company, Detroit, Mich., describes in Bulletin No. 2004 its Type SE steel plate blower designed especially for heavy duty blowing applications.

WRENCHLESS CHUCKS.—Bulletin No. 40-A descriptive of the Skinner air-operated wrenchless chucks, air cylinders and equipment, has been issued by the Skinner Chuck Company, New Britain, Conn.

PIPE CLAMPS.—The V. V. one screw malleable iron pipe clamp for fastening conduits to brick, concrete or wood are briefly described in the leaflet prepared by the V. V. Fittings Company, Philadelphia, Pa.

ARC WELDER AND CONTROLLER.—The Mann Master arc-welder and controller are described and illustrated in bulletins prepared by the Electric Welder Controller Company, 602 Bigelow boulevard, Pittsburgh, Pa.

THE FLOW METER.—The new Brown electric flow meter, in which the inductance bridge principle is used, is described and illustrated in a four-page folder issued by the Brown Instrument Company, Philadelphia, Pa.

MOTORS FOR LIGHT WEIGHT CARS.—Publication GEA-417 of the General Electric Company, Schenectady, N. Y., gives dimensions, weights and capacities of the GE-246A, 600-volt railway motor for light weight cars.

NITRALLOY.—The Ludlum Steel Company, Watervliet, N. Y., describes a new process of surface-hardening special steels in its eight-page booklet on Nitralloy, a special steel capable of being surface-hardened without distortion.

WOODWORKING MACHINES.—J. D. Wallace & Company, 134 South California avenue, Chicago, describes and illustrates in catalogue No. 403 its portable machines for wood turning, cutting, jointing and other woodworking operations.

HOISTING EQUIPMENT.—The Wright Manufacturing Company, Lisbon, Ohio, has just released catalogue No. 11 which is a comprehensive handbook on chain hoists, trolleys, hand cranes and allied equipment. Line drawings give dimensions and clearances of the various products.

FLOW METERS.—Seventeen years' progress in the development of the Republic flow meter is illustrated in a six-page folder issued by the Republic Flow Meters Company, 2240 Diversey Parkway, Chicago. This meter is designed to eliminate uncertain and inaccurate float mechanisms.

BITULUMIN.—A 30-page brochure, giving 77 questions and answers on aluminum paints and metal primers, has been issued by Hill, Hubbell & Co., San Francisco, Cal. Through these questions and answers considerable non-technical information is given on the mixing of aluminum paints, the application of Bitulumin and the principles of painting iron and steel. The illustrations in the booklet are reproductions of photographs showing the actual use of Bitulumin and Two-Fifty iron primer.

MULTI-SERVICE BALLAST CARS.—In a four-page circular devoted to Multi-service ballast cars, the Enterprise Railway Equipment Company, Chicago, describes the advantages of this type of car for handling ballast, cinders, coal, gravel, sand, ore and other materials. Four methods of discharging the load to the center of the track, both sides, center and one side, and center and both sides, are illustrated. Structural features of the Multi-service ballast cars also are outlined in detail.

AMERICAN AUTOMATIC CONNECTOR.—The Consolidated Connector Corporation, 118 Noble Court, Cleveland, Ohio, after ten years' development work on various railroads and in a number of industrial plants, is now ready to place on the market a standard connector which has been found to function satisfactorily under divergent track and climatic conditions and on any class of equipment. This connector, which is fully described and illustrated in a 20-page booklet, is equipped with an adapter, making it unnecessary to uncouple air hose in interchange and eliminating the use of tools.

Personal Mention

General

H. J. FORCE, chemist and engineer of tests of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., has resigned.

J. J. LAUDIG has been appointed acting chemist and engineer of tests of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., succeeding H. J. Force.

W. B. WHITSITT, assistant mechanical engineer of the Baltimore & Ohio, at Baltimore, Md., has been promoted to mechanical engineer, with the same headquarters, succeeding A. G. Sandman.

MYRON ROBBINS, road foreman of engines on the New York, Chicago and St. Louis, with headquarters at Ft. Wayne, Ind., has been promoted to supervisor of locomotive and fuel performance, with headquarters at Cleveland, Ohio, succeeding C. E. Trotter, resigned.

W. R. LYE, district superintendent of motive power on the New York Central, with headquarters at Elkhart, Ind., has been appointed to a similar position at Collinwood, Ohio, with jurisdiction over the Third district, succeeding O. M. Foster, who is retiring at his own request.

A. G. SANDMAN, mechanical engineer of the Baltimore & Ohio at Baltimore, Md., has been promoted to assistant to the chief of motive power, with the same headquarters. Mr. Sandman was born on October 19, 1862, in Germany, and was educated in the public schools of Maryland and at Maryland Institute. He entered railway service with the Baltimore & Ohio as machinist apprentice on October 7, 1879, becoming machinist in 1883. In 1888 he became draftsman and was promoted to chief draftsman in 1901. He became mechanical engineer on July 16, 1918.

W. R. MCMUNN, who has been appointed superintendent of rolling stock of Merchants Despatch, Inc., with headquarters at Rochester, N. Y., was born on July 19, 1876, at Williamsport, Pa., and was educated in the public schools of that place and in business college. He entered the service of the Pennsylvania in 1897, in their shops at Sunbury, Pa., remaining there until 1900. In February, 1901, he entered the service of the New York Central Railroad, rolling stock department, and served in various capacities in New York City and Albany until 1906, when he was appointed special inspector, acting in the capacity of assistant general car inspector, with headquarters at Albany. He remained in this position until 1912, when he was appointed chief clerk to the superintendent of rolling stock, with headquarters at New York. In 1914, he was appointed general car inspector, lines Buffalo and east, with headquarters at Albany, and in 1918, due to stress of the war, he was appointed assistant to the superintendent of rolling stock, with headquarters at New York. In 1921, when this position was abolished he returned to his former position as general car inspector, but with jurisdiction extended to the lines west of Buffalo, with headquarters at Buffalo. This position he was holding at the time of his appointment as superintendent of rolling stock of Merchants Despatch, Inc.

Master Mechanics and Road Foremen

J. W. MATHESON, master mechanic on the Northern Pacific at Seattle, Wash., has been transferred to Glendive, Mont.

W. E. DUNKERLY, master mechanic on the Northern Pacific at Glendive, Mont., has been transferred to Jamestown, N. D., succeeding D. S. Littlehales.

GEORGE R. WILLIAMS has been appointed road foreman of engines of the Oregon-Washington Railroad & Navigation Company, with headquarters at LaGrande, Ore.

D. S. LITTLEHALES, master mechanic on the Northern Pacific, with headquarters at Jamestown, N. D., has been transferred to Seattle, Wash., succeeding J. W. Matheson.

M. R. REED, acting master mechanic on the Pennsylvania, with headquarters at Logansport, Ind., has been promoted to master mechanic on the Ft. Wayne division, with headquarters at Ft.

Wayne, Ind., succeeding O. C. Wright, was has been assigned to special duty. The duties of master mechanic at Logansport will hereafter be performed by the general foreman.

A. M. Lawhon has been appointed master mechanic on the Southern, with headquarters at Richmond, Va., succeeding C. G. Goff. Mr. Lawhon was born on March 25, 1874, at Knoxville, Tenn. In September, 1890, he entered the service of the Southern as a machinist apprentice at Knoxville. His subsequent promotions were as follows: January, 1899, assistant enginehouse foreman; November, 1902, enginehouse foreman; July, 1914, general foreman at Princeton, Ind.; March, 1917, shop superintendent at Knoxville; June, 1923, master mechanic at Richmond; May, 1924, transferred to Alexandria, Va.

Car Department

Thos. E. Forster, general car inspector of the San Antonio & Aransas Pass, has been appointed car foreman on the Missouri Pacific, with headquarters at Anchorage, La.

F. L. Coles, general foreman of the car department of the Chicago, Rock Island & Pacific at El Dorado, Ark., has been transferred as general foreman to Biddle, Ark.

C. Yarborough, coach shop foreman of the Southern at Birmingham, Ala., has been appointed general car foreman, with headquarters at Meridian, Miss., succeeding G. A. Goodyear, deceased.

Shop and Enginehouse

F. T. Walden, general foreman of the Southern at Selma, N. C., has been transferred to Asheville, N. C.

F. T. Saywell has been promoted to machine shop and drop pit foreman of the Southern, with headquarters at Sheffield, Ala.

J. S. Flowe has been promoted to roundhouse foreman of the Southern, with headquarters at Greensboro, N. C., succeeding H. D. Broadway.

S. M. Parker has been promoted to night roundhouse foreman of the Southern, with headquarters at Greensboro, N. C., succeeding J. S. Flowe.

H. D. Broadway, roundhouse foreman of the Southern at Greensboro, N. C., has been promoted to general foreman, with headquarters at Salem, N. C.

F. W. A. Reagan has been appointed general foreman of the New Orleans Great Northern, with headquarters at Bogalusa, La., succeeding F. A. Marshall, deceased.

S. S. Talbert, machine shop foreman of the Louisville & Nashville, has been appointed general foreman, with headquarters at Mobile, Ala., succeeding W. C. McCarthy, deceased.

E. H. O'Mara has been appointed general enginehouse foreman and engine dispatcher of the New Orleans Great Northern, with headquarters at Bogalusa, La., succeeding F. W. A. Reagan.

W. T. Curlee has been appointed erecting shop foreman of the Southern, with headquarters at Spencer, N. C., succeeding K. A. Lentz.

K. A. Lentz, erecting shop foreman of the Southern at Spencer, N. C., has been promoted to shop superintendent, with the same headquarters.

F. L. Brower has been appointed day enginehouse foreman of the Southern, with headquarters at Sheffield, Ala., succeeding F. T. Saywell.

Warren D. Young, assistant foreman of the Phillipsburg enginehouse and machine shops of the Central of New Jersey, has been promoted to general foreman and car inspector, with the same headquarters.

Purchases and Stores

John Foley, forester of the Pennsylvania at Philadelphia, Pa., has become assistant to the purchasing agent.

B. P. Phillippe, assistant purchasing agent of the Pennsylvania at Philadelphia, Pa., has been promoted to fuel purchasing agent.

Montgomery Smith, purchasing agent of the Pennsylvania at Philadelphia, Pa., has been promoted to assistant to the general purchasing agent.

R. C. Harris, assistant to stores manager of the Pennsylvania at Philadelphia, Pa., has been promoted to general storekeeper, with the same headquarters.

C. B. Hall, general storekeeper of the Pennsylvania at Philadelphia, Pa., has been promoted to stores manager, with the same headquarters, succeeding C. D. Young.

E. J. Becker, general inspector of stores and supply train service on the Southern Pacific, at San Francisco, Cal., has been promoted to traveling storekeeper, with the same headquarters, succeeding J. E. Perry, on leave of absence.

Edwin J. Myers, assistant general storekeeper of the Northern Pacific, at St. Paul, Minn., has been promoted to general storekeeper, with the same headquarters, succeeding C. C. Kyle, promoted to purchasing agent. Mr. Myers began railway service on the Northern Pacific in November, 1889, as a stores laborer under the master mechanic at Fargo, N. D., in July, 1890, he became a clerk in the office of the division storekeeper at Fargo, N. D.; in July, 1900, division storekeeper at Mandan, N. D. In April, 1902, he was transferred to Glendive, Mont. He then served successively as division storekeeper at Jamestown, N. D., at Dilworth, Minn., and at South Tacoma, Wash., until 1919, when he was promoted to assistant general storekeeper, with headquarters at St. Paul.

E. J. Myers

Wilfrid P. Dittoe retired on December 1 as purchasing agent of the New York, Chicago & St. Louis and the Lake Erie & Western, with headquarters at Cleveland, Ohio, 11 months after reaching the age of 70, the time provided for retirement under the pension rules of the Nickel Plate. Mr. Dittoe was born on December 25, 1855. He spent 27 years as purchasing agent of this railroad, with a total period of 45 years in the company's service. Mr. Dittoe entered railway service in 1881 as a draftsman in the office of the chief engineer of the Nickel Plate. After several years in this capacity he was promoted successively to inspector and engineer. On September 12, 1899, he was again promoted to purchasing agent, with headquarters at Cleveland, and in July, 1922, his jurisdiction was increased to include the Lake Erie & Western.

Wilfrid P. Dittoe

Fred A. Bushnell has resigned as purchasing agent of the Great Northern, with headquarters at St. Paul, Minn. Mr. Bushnell was born on December 3, 1871, at Madison, Wis., and entered railway service on March 1, 1890, as an office boy in the office of the superintendent of motive power of the Great

Northern at St. Paul, Minn. From January, 1891, to November, 1895, he served as a clerk in the general storekeeper's office. He was then appointed division storekeeper at Kalispell, Mont. The following year he became a clerk in the general storekeeper's office at St. Paul; in May, 1899, made chief clerk in the general stores department; in November, 1905, general storekeeper, and in November, 1910, general purchasing agent of the Spokane & Inland Empire, the Spokane, Portland & Seattle, the Oregon Electric, the Oregon Trunk and the United Railways, subsidiaries of the Great Northern. In December, 1912, he returned to the Great Northern as assistant purchasing agent and in June, 1913, was promoted to purchasing agent.

C. D. YOUNG, stores manager of the Pennsylvania at Philadelphia, Pa., has been promoted to general purchasing agent, with the same headquarters, succeeding Samuel Porcher. Mr. Young entered the service of the Pennsylvania as special apprentice in 1900, and between that year and 1910, held various motive power positions on the Pennsylvania lines west of Pittsburgh. In 1911 he became engineer of tests in the Altoona shops, and in 1917 superintendent of motive power of the Philadelphia, Baltimore & Washington. Just before the armistice he was commissioned lieutenant-colonel of the engineers for service in France, returning to railroad duty later in the same year. In 1919 he became superintendent of the Schuylkill division of the Pennsylvania, in 1920 general supervisor of stores, and in January, 1924, stores manager.

C. D. Young

SAMUEL PORCHER, general purchasing agent of the Pennsylvania, with headquarters at Philadelphia, Pa., has been promoted to assistant vice-president in charge of purchases, stores and insurance. Mr. Porcher was born on December 21, 1857, in South Carolina, and was graduated from the University of Virginia. He entered railway service in 1882, as an apprentice in the Altoona shops of the Pennsylvania. He remained in the mechanical department at Altoona until 1888, when he became assistant engineer, motive power department, United Railroads of New Jersey division of the Pennsylvania at Jersey City, N. J. From 1894 to 1913 he was assistant purchasing agent and from 1913 until 1920 was purchasing agent of the Pennsylvania and subsidiaries. From January, 1918, until March 7, 1918, he was also attached to the office of the director, Division Finance and Purchase, United States Railroad Administration. On the latter date he was appointed a member of the Central Advisory Purchasing Committee, United States Railroad Administration. In March of the following year he was appointed assistant director, Division of Purchases, and on March 1, 1920, was appointed general purchasing agent of the Pennsylvania Railroad system.

Samuel Porcher

EUGENE A. CLIFFORD, assistant general purchasing agent on the Atchison, Topeka & Santa Fe at Chicago, has resigned to become general purchasing agent of the Chicago & North Western and the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at Chicago. Mr. Clifford was born on August 12, 1878, in Ireland. He received his education in the Chicago schools, and at St. Ignatius College, Chicago, entering railway service on April 10, 1901, with the Atchison, Topeka & Santa Fe. He served in various capacities on the Santa Fe until November, 1910, when he was promoted to chief clerk in the purchasing department. Three years later he became assistant general purchasing agent. During the life of the United States Railroad Administration Mr. Clifford served as a member of the purchasing committee of the Central Western region, and during the coal and railroad strike of 1922 he represented the Western roads at Washington, D. C., in the distribution of coal in co-operation with the President's coal committee.

E. C. VAN VALKENBURG has been appointed purchasing agent and general storekeeper of the Oklahoma-Southwestern, with headquarters at Tulsa, Okla., taking over duties previously performed by R. V. MILLER, general manager of the company.

Obituary

E. C. INGALLS, division storekeeper on the Missouri Pacific, died on December 1 at Dupo, Ill.

WILLIAM P. McCARTHY, general foreman of the Louisville & Nashville at Mobile, Ala., died suddenly on November 6, 1926.

A. H. POWELL, superintendent of shops of the Western Pacific, who died on November 28 at Sacramento, Cal., was born in West Virginia. One of his earliest positions in a railroad mechanical department was as master mechanic on the Chicago & Eastern Illinois at Villa Grove, Ill., where he remained until 1904, when he became master mechanic on the Cincinnati, Hamilton & Dayton at Ivorydale, Ohio. In 1907 he was appointed assistant master mechanic on the Denver & Rio Grande at Pueblo, Colo., and in the following year he was promoted to master mechanic on the Colorado Midland, the Denver & Rio Grande and the Rio Grande Western, with headquarters at Grand Junction, Colo. He was appointed master mechanic on the Western Pacific in 1910 and in 1915 he was promoted to general master mechanic. Mr. Powell was promoted to superintendent of shops, with headquarters at the Jeffrey shops, Sacramento, Cal., on November 1, 1921.

J. M. SNODGRASS, professor of railway mechanical engineering, department of railway engineering, University of Illinois, died on Saturday, December 4, following an operation for cancer. Professor Snodgrass was graduated from the University of Illinois in 1902 with the degree of B. S. in mechanical engineering. From 1902 to 1906 he was instructor in mechanical engineering and in railway engineering at the university. He was then employed by the American Locomotive Company at Schenectady, N. Y., returning in 1908 to the University of Illinois as associate and assistant professor in the department of mechanical engineering and special investigator in the engineering station. In 1913 he became assistant professor and later professor of railway mechanical engineering, department of railway engineering. Professor Snodgrass also had been employed for periods varying from two to six months by the Lake Shore & Michigan Southern, the Illinois Central, the Cleveland, Cincinnati, Chicago & St. Louis, the Commonwealth Edison Company and other companies. He was chairman of Sub-Committee 15 on Locomotives of the Committee on Power Test Codes of the American Society of Mechanical Engineers.

Prof. J. M. Snodgrass